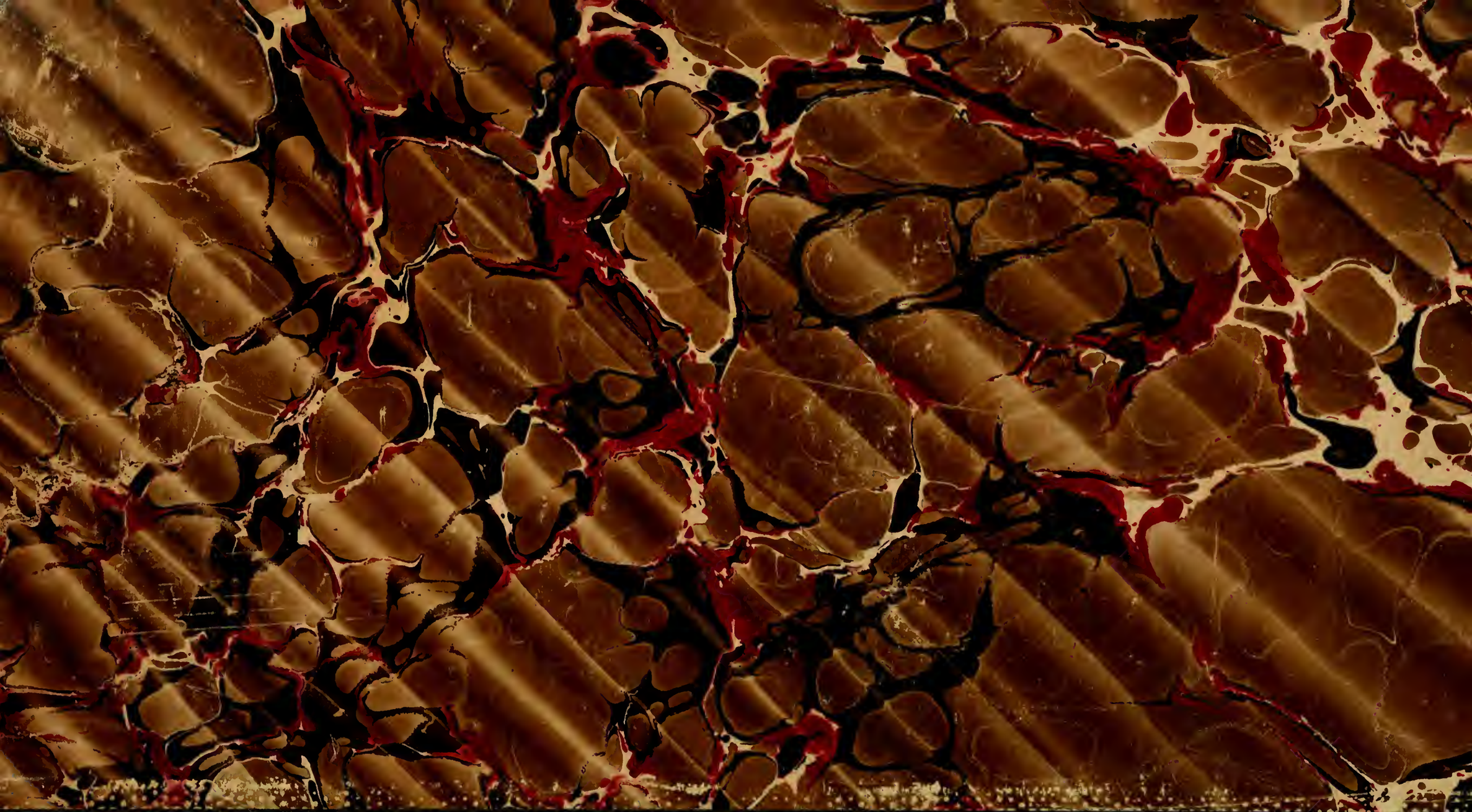


SHOUT
SHARE
IT

Library of the Museum

OF

COMPARATIVE ZOÖLOGY,

AT HARVARD COLLEGE, CAMBRIDGE, MASS.

The gift of Denison University

No. 11,590

July 3, 1891 — April 23, 1895.

GRANVILLE, OHIO.

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOL. VIII. PART I.

WITH TWO PLATES.

EDITED BY

W. G. TIGHT, M.S.,

DEPARTMENT OF GEOLOGY AND NATURAL HISTORY.

GRANVILLE, OHIO, MAY, 1893.

PRESS OF GRANVILLE TIMES.

ADDITIONAL NOTES ON THE CLADOCERA AND OSTRACODA OF CINCINNATI, OHIO. I. SYSTEMATIC PORTION, WITH DESCRIPTIONS OF NEW SPECIES. II. LATE LARVAL HISTORY OF CYPRIS HERRICKI. III. ILYOCRYPTUS SPINIFER, Herrick, NOT THE SAME AS ILYOCRYPTUS LONGIREMUS, Sars.

By C. H. Turner.

[Plates I, II.]

I. Systematic Portion.

In continuing these notes on the Cincinnati Cladocera and Ostracoda it is thought desirable to give under each species as complete references as possible to the American writers who have described it. To accomplish this it has been necessary to repeat a few of the species described in my former paper.[1]

ORDER CLADOCERA.

Family SIDIDAE.

Genus Sida, Straus.

Sida crystallina, ... O. F. Müller.
Sida crystallina, . . . E. A. Birge, Notes on Cladocera, 1878, p. 2.
Sida crystallina, . . . S. A. Forbes. On Some Lake Superior Entomostraca, 1890, p. 714.
Sida crystallina, . . . E. A. Birge, List of Crust. Clad. f. Madison, Wis., 1891, p. 382.

Family DAPHNIDAE.

Genus Scapholeberis, Schödler, 1858.

Scapholeberis mucronata, O. F. Müller.
Scapholeberis mucronata, . . . E. A. Birge. Notes on Cladocera, 1878, pp. 8-9; pl I, fig. 7.
Scapholeberis mucronota, . . . S. A. Forbes. On Some Lake Superior Entom., 1890, p. 712.

---

[1]Notes Upon the Cladocera, Copepoda, Ostracoda, and Rotifera of Cincinnati. *Bul. Sci. Lab. Den. Univ.* Vol. VI, part II, pp. 57-74, pl. I, II.

Additional locality: In a shallow, sluggish, grassy creek; Lockland, O. September, 1892.

Genus Simocephalus, Schödler, 1858.

Simocephalus vetulus, O. F. Müller.
Simocephalus vetulus, . . . E. A. Birge. Notes on Clad., 1878, p. 8.

Additional locality: In a shallow, sluggish, grassy creek; Lockland, O. September, 1892.

Genus Daphnia, Schödler.

Daphnia pulex, O. F. Müller.
Daphnia pulex, . . . E. A. Birge. Notes on Clad., 1878, pp. 11-12; pl. I, fig. 11.

Additional locality: During high water in the spring of 1892, myriads of this species were found in a large creek (Mill Creek). It is very probable that these were washed into the creek, by the flooding of the ponds near its banks.

Normally at this place the ephippal females of this species are formed about the middle of September. But last June numerous ephippal females were collected from small pools that were rapidly drying up.

Family BOSMINIDAE.

Genus Bosmina, Baird, 1850.

Bosmina cornuta, Jurine.
Bosmina cornuta, . . . E. A. Birge. Notes on Cladocere, 1878, p. 15, pl. II, fig, 10.

This species seems to be rare. I have only encountered it once, when I found several in a shallow, grassy pool at Tusculum, Ohio. Length, 0.256 mm.

Family LYNCEIDAE.

Sub-family LYNCEINAE.

Genus Camptocercus, Baird, 1851.

Camptocercus macrurus, O. F. Müller.
Camptocercus macrurus, . . . E. A. Birge. Notes on Cladocera, 1878, p. 33.
Camptocercus macrurus, . . . C. L. Herrick. Final Report on Minn. Crust., 1884, p. 83, pl. E, fig. 10.

The specimen here identified as a member of this species is smaller than the specimens found by Prof. Birge in Massachusetts and

Wisconsin, and by Prof. Herrick in Minnesota, yet it agrees with Prof. Herrick's description in all other respects. Legth, 0.63 mm. Height, 0.42 mm.

Habitat: Shallow, grassy creek, Lockland, O.

Genus Leydigia, Kurz.

Leydigia quadrangularis, Leydig.

Leydigia quadrangularis, . . . E. A. Birge. List of Crust. Clad. f. Madison, Wis., 1891, p. 393.

Leydigia quadrangularis, . , . C. L. Herrick. Final Report. Minn. Crust., 1884, p. 88, pl. H., fig. 4.

Length, about 1 mm. Height, about 0.5 mm.

Habitat: Clifton, in large canal basin, on bottom, not abundant. July. Lockland, shallow, sluggish, weedy creek; abundant. September.

Genus Dunhevidia, King.

Dunhevidia setiger, Birge.

Crepidocercus setiger, , . . E. A. Birge. Notes on Cladocera, 1878, p. 26; pl. I, fig. 18.

Dunhevidia setiger, . . . C. L. Herrick. Final Rep. Minn. Crust. 1884, p. 91; pl. F, fig. 13.

Dunhevidia (crepidocercus) setiger, . . . E. A. Birge. List of Crustacea Cladocera from Madison, Wis.; p. 394; pl. XIII, fig. 20.

This species has been encountered here but once. On the 28th of August, 1892, several were found in a small weedy pool.
Length of female about 0.43 mm. Height of same about 0.31 mm.

Genus Alona. Sars, 1862.

Alona porrecta, Birge.

Alona porrecta, . . . E. A. Birge. Notes on Cladocera, 1878, pp. 29-30; pl. I, fig. 16.

Additional locality: Shallow, weedy, canal basin in Camp Washington.

Length of female, 0.35 mm. Height, 0.22 mm.

Alona glacialis, Birge.

Alona glacialis, . . . E. A. Birge. Notes on Cladocera, 1878, pp. 30-31.

Genus Pleuroxus.

Pleuroxus denticulatus, Birge.

Pleuroxus denticulatus, . . . E. A. Birge. Notes on Cladocera, pp. 21, 21; pl. I, fig. 21.

Pleuroxus denticulatus, . . . E. A. Birge. List of Cladocera from Madison, Wis., 1891, p. 395; pl. XIII, fig. 21.

Additional locality: Lockland, O. Shallow, weedy, sluggish pool.

Length of female 0.44 mm.—0.54 mm. Height, 0.32 mm.—0.33 mm.

Pleuroxus hamatus, Birge.

Pleuroxus hamatus, . . . E. A. Birge. Notes on Cladocera, 1878, pp. 22, 23; pl. II, figs. 13, 14.

Additional locality: Lockland, O. Sluggish, shallow, weedy creek.

Length of female of Lockland specimen, 0.5 mm. Height, 0.3 mm.

Genus Chydorus, Leach.

Chydorus sphaericus, O. F. Müller.

Chydorus sphaericus, . . . E. A. Birge. Notes on Cladocera, 1878, pp. 23, 34; pl. II, fig. 19.

Chydorus sphaericus, Baird, . . . S. A. Forbes. Some Lake Superior Entomostraca, 1890, p. 7 2.

Length of female, 0.5 mm. Height, 0.43 mm.

Additional locality: Shallow, sluggish, grassy creek, Lockland.

ORDER OSTRACODA

Family CYPRIDIDÆ.

Genus Cypria, Zenker.

Cypria inequivalva, sp. n.

[Plate I; Figs. 1, 8.]

Shell inequivalve, one valve overlapping the other in front. Valves glossy, finely pubescent.

In fresh specimens, near the cephalic end of the shell, there is an irregular cross shaped dorsal dark spot, [fig. 1, 2], the arms of which extend latero-ventrad along each valve for about one half the height of the valve. Near the caudal extremity of the shell there is another irregular dorsal dark spot. This spot is somewhat fan shaped, with the expanded portion directed caudad. Occasionally, on the ventral surface, about one third the length of the valve from the cephalic extremity, a small dark spot is seen. In fresh specimens these markings are very pronounced; but in alcoholic specimens, they are usually more or less obscured.

Viewed from the side [fig. 1] the shell is sub-reniform, higher

near the middle. It is about twice as long as high. Dorsal margin, feebly convex; cephalic margin, convex; ventral margin, nearly straight, slightly concave in the middle; caudal margin convex.

Viewed from above [fig. 2] the shell is sub-elliptical, inequivalve, one valve overlapping the other in front Shell widest near the mid dle. Cephalic extremity about as wide as the caudal. All margins convex. Hinge line straight.

Viewed from below [fig 3] shell presents the same outline as when viewed from above, but the line of contact of the two valves is sinuated.

Viewed from the end, the shell is oval, widest in the middle, ventral margin about as wide as dorsal.

Antennules typical for the genus.

Antennae of female [fig. 4] composed of four joints, the joints diminishing in size from the most proximal to the most distal joint. The most proximal joint bearing at about the middle of its ental margin a long seta. The next joint bears at about the middle of its ental margin the usual biarticular sensory hair and at its disto-ental angle a moderately long plumose seta, this seta extends to about the base of the terminal claws. From the base of the penultimate joint arise five very long non-plumose setae, these setae extending far beyond the tips of the terminal claws. At the middle of its ental border this joint bears a short seta and opposite this on the ectal border there is a slightly longer seta. From the disto-ental angle of this joint arise two short seta. From the ectal half of its distal margin arise two long claws; one of these claws extends beyond the tip of the claws springing from the terminal joint, while the other extends nearly to the tip of those claws. At the extremity of the terminal joint there are two large claws and two short setae; one of these seta is located at the disto-ental angle and the other at the disto-ectal angle of the joint.

First foot of female [fig. 5] long and slender, composed of five joints. The most proximal joint large, the broadest of all. The next joint the shortest of all. The antipenultimate joint about as long as the most proximal, but more slender. From the margin of this joint arise two short setae. From the disto caudal angle of this joint arises a long seta which extends to beyond the base of the terminal claws. From near the disto-cephalic angle of this joint arises a short seta. Along the cephalic margin of the penultimate joint there is a longitudinal row of fine hairs. From the disto caudal angle of this joint arises a seta medium length. From the extremity of the terminal

joint arises a long claw; this claw is much longer than the joint and appears to be composed of two portions; a short proximal and a long distal portion. From the cephalic margin of the proximal portion arises a short seta.

Second foot of female [fig. 6] composed of four joints, the joints diminishing in size from the most proximal to the most distal joint. The most proximal joint bears at about its proximo-caudal angle a long plumose seta which is as long as the joint; and from the distal third of its cephalad margin arises a somewhat shorter seta. From the distal fourth of the cephalic margin of the antipenultimate joint arises a seta. From a corresponding point on the penultimate joint there also arises a seta. From the extremity of the terminal joint arises two long and two short setae. The two long setae are about as long as the combined lengths of both the ultimate and the penultimate joints. The two shorter setae are but little longer than the terminal joint.

Post abdomen [fig. 7] is curved, bearing one terminal claw and at its base a short terminal spine. On the convex surface there is a sub-terminal claw.

Verticillate sac [fig. 8] of male as usual in this genus. It seems to be enclosed by a transparent capsule.

Length of female, 0.52 mm. Height, 0.36 mm. Breadth, 0.26 mm.

Habitat: This little species is very abundant here. The majority of the ponds that contain either grass, water plants or hydrodictyon, contain it. Found at Tusculum, Clifton, Mill Creek bottoms.

Genus Cypris, Müller.

Cypris incongruens, . . Ramdohr [Pl. I; fig. 9, 16; pl. II, fig. 17, 21.]
Cypris incongruens, . . . G. S. Brady. Recent British Ostracoda, pp, 362, 363; pl. XXIII, figs. 16, 22.
Cypris incongruens, . . . G. S. Brady and Alfred M. Norman. Mon. of Marine and Fresh Water Ost. of N. At. and N. W. Europe; Part I, pp. 73, 74; pl. XII, figs. 8, 9.

The American representative of this species is almost an exact counterpart of the European species. A comparison of the figures given here with those in the monographs referred to above, will show how close is the resemblance.

Length of female, 1.35 mm. Height, 0.75 mm. Habitat: Rare. Found in stagnant water.

Cypris crenata, sp. n.

[Plate II, Figs. 22-32.

Cypris sp (?), . . . C. H. Turner. Bull. Sci. Lab. Denison Univ,, Vol. VI, part II, p. 71; pl. II, figs. 11, 13.

The shell is equivalve, very thin, the free margins of one valve is bordered with blunt teeth. The ventral margins of both valves bear hairs. Shell reticulated with contorted lines, the reticulations are most distinct on the cephalic portion of valve. Lucid spots about nine, sub-central. Color, various shades of greenish yellow. The caudal half of shell of male appears to be marked with concentric retort shaped lines. Since the shell is very thin this appearance may be due to the presence of spermatozoa or spermatophores within the shell.

Viewed from the side [fig. 22] the shell is sub-reniform, highest about the middle, cephalic and caudal extremities about the same width. Caudal, dorsal, and cephalic margins convex; ventral margin nearly straight, slightly convex, at the middle.

Viewed from above [fig. 23] the shell is sub-oval, widest behind the middle. Caudal margin rounded, cephalic margin bluntly pointed. Hinge line sinuate.

Viewed from below [fig. 24] same as when viewed from above. Line of contact of valves sinuate.

Viewed from end [fig. 25] shell is oval, a little higher than wide.

Antennules [fig. 25] and antennae as usual in genus Cypris.

The mandible [fig. 26] terminates in four large teeth, between each two of these teeth there is a short, slender rod. The mandibular palp consists of four joints. The first joint is very large, about as large as the combined lengths of the other three; it bears about the middle of its dorsal surface a branchial appendage, which in turn bears four long sétae; and from the distal fifth of its ventral surface arises two long setae. The antipenultimate joint is very short; from the distal half of its dorsal surface arises two long setae and one short one. The penultimate joint is long; from its disto-dorsal extremity arise three long and one short setae; from the disto-ventral angle of the shell arises two short setae. The terminal joint is very narrow and about as short as the antipenultimate joint; at its tip it bears four short claws.

The first foot [fig. 27] of male is composed of four joints. The most proximal joint is large. The antipenultimate joint is about as long as the preceding joint. From its disto-caudal margin arises a medium sized seta; and from its disto-cephalic margin arises a somewhat smaller seta. The terminal joint is about the same size as the penultimate. From its disto-caudal margin arises a medium sized seta and a small spine; from its disto-cephalic margin arises a very short spine. From the distal end of joint arises a long claw; the claw is about as long as the combined lengths of the three distal joints. The claw is composed of a short basal and a long terminal portion. At the disto-caudal portion of the basal joint of claw there is a short seta; at the disto-cephalic margin of the same joint there is somewhat smaller seta. A row of fine hairs extends along the middle portions of the caudal margin of the terminal joint of the claw.

The second foot of the male [fig. 25] is composed of three joints. The antipenultimate joint is medium sized. From about the middle of this joint arises a median seta; and from the disto-caudal margin a long seta. The penultimate joint is the longest joint; from its disto-cephalic margin arises a median spine. The terminal joint is about as long as the antipenult; from the middle of its cephalic border arises a short seta; from its tip arises a short seta; from its tip a more or less curved short claw and a median seta.

The post-abdomen [fig. 29] of male is curved. At its tip there is a long claw and a short seta. Entad of this terminal claw is another long claw; further entad arises a short seta. Post-abdomen of female is straighter, otherwise the same.

In the male there is a pair of verticillate sacs [fig. 30]. From the distal extremity of each arises a vas deferens. Length of sac, 0.35 mm.; width, 0.11 mm. The copulative organ of male consists of distinct halves, each half of which is composed of a large basal and a small terminal portion. The basal portion of each division receives at its proximal end a vas deferens. Length of copulative organ, 0.37 mm. Width, 0.11 mm.

Length of female, 1.23 mm. Height, 0.63 mm Width, 0.60 mm. Length of male, 1.14 mm. Height, 0 60 mm. Width, 0.45 mm. Habit: Abundant in canal basin containing water plants or grass. Clifton, Camp Washington.

II. Late Larval History of Cypris Herricki, Tur.

[Plate I, fig. 33-39; plate II, fig. 40-42.]

Historical.—As far as I can discover we are indebted to Professor C. Claus, for all we know about the development of the Ostracoda.[1] His researches upon Cypris ovum [Cypria opthalmica (Jurine) Brady] led to the discovery that this form passes through nine larval stages. This Cypria escapes from the egg as a free swimming nauplius; but the nauplius differs from the typical nauplius in two important particulars: The animal is enclosed in a bivalve shell and none of the appendages are biramous. In the second stage the mandible attains its adult form and the first pair of maxillae and the first pair of feet appear. The maxilla resembles somewhat a phyllopod appendage. In the third stage no essential change occurs. In the fourth stage the first pair of maxillae attain their final form and the second pair of maxillae appear. The rudiment of the post-abdomen is also visible. In the fifth stage the second pair of maxillae develop a blade and function as an ambulatory organ. In the sixth stage the second pair of maxillae lose their ambulatory function, and at the same time the second pair of feet is formed. In the seventh stage all appendages have attained about the permanent form. The next two stages are characterized chiefly by internal changes.

In this connection it is not intended to discuss the early stages of *Cypris Herricki*. These remarks will be confined to what corresponds to the seventh to ninth ecdyces of *Cypria opthalmica*, Jurine. Not only that, but the remarks will be restricted to the external morphology. It is hoped to discuss the internal anatomy in a subsequent paper.

The earliest stage here discussed has been compared to the seventh stage of *cypria opthalmica*, Jurine, because in that stage the appendages have attained about their permanent form; but it must not be supposed that in this Cypris there are only two subsequent larval stages. These stages are tabulated in the following table:

---

[1] Zur Kenntnis der Jungenformen von *Cypris ovum*. *Zeit. f. wiss. Zool.* Bd. XV, 1865.

Beitrage zur Kenntnis d. Ostracoden. Entwicklungsgeschicte von *Cypris ovum*. *Schriften d. Gesell. zur Beförderung d. gesamm. Naturwiss. zu Marburg*, Vol. IX, 1868.

Untersuchungen zur Erforschung der genealogischen Grunlage des Crustaceen Systems. Wien 1876.

TABLE I.

Stages.	*Length*	*Height*	*Position of Dorsal Hump, etc.*	*Form of Post-abdomen.*
A	0.90 mm.	0.57 mm.	Some distance in front of middle. Teeth on caudal margin of shell.	Rudimentary; fewer spines than in adult; terminal about as long as or longer than remainder of the appendage.
B	1.32 mm. to 1.38 mm.	0.71 mm. to 0.84 mm.	Approaching middle. Teeth on shell much larger.	Form normal; number of spines normal; ratio of the length of the post-abdomen greater than in adult.
C	1.98 mm.	1.20 mm.	Near the middle. Teeth on shell large.	Ratio of the length of terminal spine to the length of post-abdomen more nearly normal than in B.
D	2.79 mm.	1.64 mm.	At middle. Teeth disappearing.	About as in adult.
Adult.	3.00 mm.		At middle. No teeth on shell.	

In *Cypria opthalmica* (Jurine) Claus found that by the time the seventh stage was reached, the shell had practically assumed its final form. In the form here described there are pronounced differences between the earliest stage here considered and the adult.

In the adult of *Cypris Herricki*, the dorsal border of the shell is almost uniformly convex and the cephalic border of the shell is about the same height as the caudal. In stage A [fig. 33], however, the shell is highest near the cephalic extremity, and the cephalic border of the shell is higher than the caudal. As the animal passes through stages B to D, the highest point of shell moves gradually towards the middle and the height of the caudal margin of the shell approaches more and more the height of the cephalic margin.

In the adult *Cypris Herricki*, the caudal margin of the shell is entire. But in stage A, the caudal margin of the shell is bordered with minute teeth [fig. 34]. In this stage the teeth are quite small and might easily be overlooked; but in stage B [fig. 35], these teeth have become very conspicuous. Indeed, they are the characteristic feature of the shell. These teeth are present throughout stage A to D, but in stage D they have begun to disappear. In the adult stage there is no trace of these teeth.

A careful study of the adult shows that the shell is covered with hairs. These hairs are very conspicuous in stage A. The shell of the adult is marked with very conspicuous dark bands.

An effort has been made to discover at what period these bands appear, and to see if they conform to the rules laid down by Professor Eimer. The characteristic bands on the shell may be present in any stage from A to the adult; and when they are present they do not differ essentially from the markings on the adult. The chief points of difference being variations in the width of the bands. In all examples of stages C and D examined, these characteristic markings were found; but in stages A and B, they were occasionally absent. An examination of figure 35 will show that some of these bands are longitudinal while others are oblique.

Professor Eimer has attempted to establish the following rule for the formation of oblique markings on animals.[1] Oblique markings first appear as longitudinal lines. These lines become resolved into dots, these dots, in turn, rearrange themselves in oblique lines. If these laws were applicable to the markings on *Cypris Herricki*, in stages A and B, where we have some specimens with bands and others without them, we ought to find some transition stages—some stages in which the oblique markings were represented either by parallel lines, or by series of dots. But such is not the case. The shell is either unmarked by bands, or both oblique and longitudinal bands are present.

As stated above, in stage A the appendages have practically assumed their permanent form. The post-abdomen is a notable exception. This appendage is quite rudimentary; not only has it not yet acquired the typical number of setae, but the longest terminal seta is as long as, or longer than, the remainder of the post-abdomen. This great relative length of the terminal seta is due, not to an over-development of the seta; but to an under-devolopment of the body of the post-abdomen. That the post-abdomen appears to be the last appendage to development is rendered more striking by the discovery of C. Claus that the post-abdomen appears before the formation of the second pair of legs. In stage B the post-abdomen has developed the permanent number of setae, but the ratio of the length of the terminal seta to the length of the body of the member is much greater

---

[1] *G. H. Th. Eimer.* Organic Evolution is the Result of the Inheritance of Acquired Characters According to the Laws of Organic Growth. Translated by J. T. Cunningham, 1890, p. 73.

than in the adult. In passing through stages C and D, the parts of the post-abdomen gradually assume the proportions of the adult.

Every precaution has been taken to be sure that all the stages above described were stages of one and the same animal. A definite number of each stage were isolated in saucers of water and a record kept of the number placed in each saucer, and also of the stage of growth exhibited by each set at time of isolation. The water used was collected from a pool which did not contain any Ostracodes which in the least resembled those under consideration. As a further precaution the water was allowed to stand in the laboratory a couple of weeks. The loss in volume was replaced by river water, taken from the city hydrant. I never have found any Ostracoda in said river. Thus there was no possibility of the water containing the eggs of *Cypris Herricki*, The larvæ stages which were placed in this water were examined from time to time. In every case the specimens developed into the adult form.

The morphological differences between the shell of stage B and the shell of stage A, and between the shell of stage B and the adult are certainly as great as the morphological differences between the shells of closely allied species. The morphological differences between stage A and the adult are differences, not only in the shell structure, but also in the structure of the post-abdomen. And these differences are as great as those between the genus Cypris and the genus Cypridopsis. These facts show that shell structure of Ostracodes, when taken alone, is of almost no taponomic value.

These facts also have phylogenetic significance. These various larval stages are resting stages in the development of *Cypris Herricki*. Since it is true that the ontogenetic development of an individual is a rapid and compact repetition of its phylogenetic history, these larval forms must represent past stages in the evolution of *Cypris Herricki*. As has been stated above, stage A corresponds very closely to the genus *Cypridopsis*. The main distinction between the genus *Cypris* and the genus *Cypridopsis* is the difference in the form of the post-abdomen. In the genus *Cypridopsis* the body of the post-abdomen is but slightly developed, while the setae are quite long. In stage A, in the larval history of *Cypris Herricki* the post-abdomen is in this rudimentary condition; thus it corresponds very closely to the genus *Cypridopsis*. Not only that, but the unbanded forms of this stage correspond very closely to *Cypridopsis hystrix*, Herrick.[1] Indeed, when

[1] C. L. Herrick, Contribution to the Fana of the Gulf of Mexico and the South, 1887. p. 30, pl. IV, fig. 6.

this stage was first encountered, it was supposed to be a *Cypridopsis*. While working at its anatomy, a specimen with the markings characteristic of *Cypris Herricki* was discovered. This led to an investigation of the larval history of the crustacean.

These facts give us a very strong hint that the genus *Cypris* has been evolved directly from the genus *Cypridopsis*. Should future research show that all members of the genus *Cypris* have a *Cypridoysis* stage,[1] the discovery would give much weight to the hint. And if, at the same time the internal structure should prove to be similar, the evidence would be conclusive.

III. Ilyocryptus spinifer, Herrick, not the same as Ilyocryptus longiremus, Sars.

In a recent paper[2] Professor Birge remarks that it cannot be decided whether *Ilyocryptus spinifer*, Herrick, is identical with *Ilyocryptus longiremus*, Sars. or not, because none of the specific characters of the former are mentioned or figured. Evidently Professor Birge has not seen a paper written by the author of the Final Report on Minnesota Crustacea, the next year after that report was published;[3] for in that paper the author has not only fully described and figured *Ilyocryptus spinifer*, Herrick, but he has also made comparisons between it and three then known European representatives of the genus. For convenience, I quote the entire description :

"The size varies greatly, a full grown female with eggs in the brood cavity is nearly 0.90 mm. long and 0.70 mm. high, while a smaller female measures 0.65 mm. long by 0.44 mm. high. The form of shell is nearest like that of *I. acutifrons*, the height being less than in *I. sordidus*, and the angle between the ventral and posterior margins less than in *I. agilis*. The entire length of the post-abdomen in the large female is 0.56 mm. measured to the base of the caudal stylets, of which length 0.168 mm. pertains to the claws. The width of the post-abdomen is but 0.14 mm. Thus it is evident that the proportions of the post-abdomen differ greatly from any of the other species, it being very long and narrow. The terminal claws

---

[1] It must be remembered that *Cypris ovum* Claus is a member not of the genus *Cypris*, but of the genus *Cypridopsis*.

[2] List of Crustacea, Cladocera from Madison, Wis., 1891. p. 393.

[3] *C. L. Herrick*—Mud-inhabiting Crustacea. Bulletin of the Scientific Lab. of Denison University. Vol. I, 1885; pp. 39-41 ; pl. IX, figs. 1-3.

are exactly as in *I. agilis*, having two small basal spines and a few sharp serrations near the apex, anteriorly. Near the base of the claw is a cluster of small spines of two sizes, then begins a series of about sixteen lateral teeth averaging 0.02 mm. in length and extending to the sides of the anus. Above this point the contour of the margin is convex and is ornamented with nine spines twice as long as the preceding. Then follow the prominences which bear the long and simple caudal setae. Besides the above mentioned spines there are four spines on either side upon the lower posterior angle of the post-abdomen which are four times as long as those of the previously mentioned continuous series (i. e. 0.08 mm.) Above the abdomen is hirsute or thorny as in *I. agilis*, and the process for closing the brood sac is similar. It will be seen that the post-abdomen differs in armature as much as in form from the other species. From *I. sordidus* it differs in the following points: The claws are not pectinate behind, but are serrate in front, the anal opening is higher and the details of the spines vary; from *I. acutifrons* it differs in that the claws are not pectinate, neither is there a spine in front of the claws, and the anus is not terminal; from *I. agilis* it differs. in that the shape is different, there are fewer enlarged spines, and the shape of the nine spines above the anus is different. The head is convex, resembling *I. sordidus* most nearly, but the antennules are much longer and more slender than in any other known species. They are 0.17 long and about 0.016 mm. wide, while the longest seta is 0.084 long. The antennae are almost exactly as in *I. sordidus*. The labrum has the usual shape, as have the jaws and other appendages. The margins of the shells are ornamented with spines simply pectinate or barbed, as in *I. agilis*. In *I. sordidus* these spines are variously branched and in that form alone of the European species, according to Kurz, is there a failure to perfect the moult; in our species, which has simply pectinate setae, the old coverings are all but uniformly retained. The spines of the lower posterior margin are from 0.16 mm. to 0.20 mm. long."

Since we have a full description of *Ilyocryptus spinifer*, Herrick, we have the data for deciding whether it is identical with *Ilyocryptus longiremus*, Sars, or not. To facilitate the comparison the following table has been compiled. The characteristics of *I. longiremus* are taken from Professor Birge's description and illustration. The characteristics of *I. spinifer* are taken from the above quotation and the illustrations which accompany it.

TABLE II.

Shell not perfectly moulted,	Both.
Claw of post-abdomen not pectinate,	Both.
Fine bristles in front of the claw,	Both.
Anus about midway post. border of post-abomen,	Both.
Marginal spines of shell nowhere much branched,	Both.
Upper spines af supra-anal series like remainder,	Both.
Elongated anal spines on either side, 3 or 4, " " " " " 4 or 4,	I. longiremus. I. spinifer.
Antenules less than 8 times as long as brood, " more " " " " " " " "	I. logniremus. I. spinifer.
Antennal setae as long as or longer than height of shell. " " about half as long as height of shell.	I. logniremus. I. spinifer.
Supra-anal teeth 5-7, " " 9,	I. logniremus. I. spinifer.
Post-anal spines äbout 8, " ." " 9,	I. longiremus. I. spinifer.
Post-anal teeth 11-12, " ." about 15,	I. longiremus. I. spinifer.

The above table shows that these two species are very closely related, yet there are distinctive points enough to make them two distinct species.

DESCRIPTION OF PLATES.

Plate I.

Fig. 1. *Cypria inequivalva*, sp. n., Lateral view, female.
Fig. 2. " " Dorsal view, "
Fig. 3. " " Ventral view, "
Fig. 4. " " Antenna, "
Fig. 5. " " First foot, "
Fig. 6. " " Second foot, "
Fig. 7. " " Post-abdomen, "
Fig. 8. " " Verticillate sac, male.
Fig. 9. *Cypris incongruens*, Randohr. Lateral view, female.
Fig. 10. " " Dorsal view "
Fig. 11. " " Ventral view, "
Fig. 12. " " Antennule, "
Fig. 13. " " Antenna, "
Fig. 14. " " Mandible, "
Fig. 15. " " First maxilla, "
Fig. 16. " " Second maxilla, "

Fig. 40. *Cypris Herricki*, C. H. Turner. Larval stage A, end view.
Fig. 41. " " " " " dorsal view.
Fig. 42. " " " " " ventral view.

Plate II.

Fig. 17. *Cypris incongruens*, Randohr. First foot, female.
Fig. 18. " " Second foot, female.
Fig. 19. " " Post-abdomen, female.
Fig. 20. " " Portion of shell.
Fig. 21. " " Lucid spots.
Fig. 22. *Cypris crenata*, sp. n. Lateral view, female.
Fig. 23. " " Dorsal " "
Fig. 24. " " Ventral " "
Fig. 24A. " " End " "
Fig. 25. " " Antennule, male.
Fig. 26. " " Mandible, female.
Fig. 27. " " First foot, male.
Fig. 28. " " Second foot, male.
Fig. 29. " " Post-abdomen, male.
Fig. 30. " " Verticillate sac, male.
Fig. 31. " " Copulative organ, male
Fig. 32. " " Portion of ventral margin of shell, female.
Fig. 33. " " Stage A, lateral view.
Fig. 34. " " Stage A, teeth on caudal margin of shell.
Fig. 35. *Cypris Herricki*, C. H. Turner. Stage B, Lateral view.
Fig. 36. " " Stage B, Dorsal view.
Fig. 37. " " Stage A, Post-abdomen.
Fig. 38. " " Stage B; Post-abdomen.
Fig. 39. " " Stage B, Ventral view.

THE *ERUCTAVIT*, AN OLD FRENCH PARAPHRASE IN VERSE OF PSALM XLV.

BY GEORGE F. MCKIBBON, A.M.

Presented before the Denison Scientific Association, April 22, 1893.

This poem of the twelfth century, though of unknown authorship and mediocre in style and thought, may claim attention for several reasons. It is an example of the curious allegorical interpretation of the Bible, so prevalent in medieval times. In the numerous copies which the popularity of the poem caused, it contributes to the material for studying the different forms of the early language of France.

But, long before the present interest in medieval life, thought and speech had begun, the *Eructavit* was known for another reason: it was composed under the patronage of a royal personage. From the opening lines, and from the closing address also, (though some copies lack both passages), it appears to have been written for Marie of Champagne, sister of Philip Augustus, King of France. She was the literary patron of several poets. Chrétien de Troyes wrote for her his *Roman de la Charette*. Quesne de Béthune probably numbered her among the readers of his lyrics. At her suggestion Everat prepared a poetic translation of *Genesis*, finishing the task after her death in 1198. Perhaps a score of years earlier, and also at her wish, the *Eructavit* was composed. Some ascribe it to Guillaume the Norman, others, with more reason, to Gautier de Coinsy, both contemporaries of the princess and writers on sacred subjects.

The poem is found in Mss. at Madrid, Rome, Vienna and London; but copies are most numerous at Paris, where (without counting fragments) five are preserved. All these were carefully examined except the Vienna copy. Eight or nine copies were made from as many manuscripts, and some of the more important readings from these shall be compared, but no attempt shall be made to restore the original text. The text here reproduced, however, may be considered the oldest and nearest to the original of all that exist, being that of Ms. 15606 at the British Museum. It is in the Burgundian dialect, in which the poem was originally composed, and is assigned to the thirteenth century.

In the same century and in the fourteenth were written the Mss. that have furnished the other copies. They were made in parts of

the then French-speaking world as far apart as England and Southern France, and offer many differences in language and expression. As to the plan of the poem, however, they agree quite closely. This may be briefly stated as follows: An address, 14 lines, to the "dame de Champagne." The introduction proper, which alludes to royal marriage customs and describes David as writing an Epithalamium in prophetic anticipation of the nuptials of the Lord and his Church, and as bringing his song to the gate of Paradise,—190 lines. The paraphrase itself then begins, setting out with a passage from the Latin original of the Psalm, which is then freely translated and incorporated in the dialogue already begun between the angel at the gate and the inspired poet. This dialogue is carried on a little further; thereafter the plan appears to be merely to cite the original Latin in brief passages and to develop therefrom long and fanciful explanations. The princely bridegroom's sword, bow, arrows, throne, garments; the bride's beauty, her ornaments; the offspring of the pair; are all treated at length in the characteristic allegorical manner. An epilogue, addressed to the same person as at the beginning, concludes the poem.

[CHI COUMENCHE ERUCTAVIT.]

1

Une chanson que David fit,
Que nostre sires ou cuer li mit,
Dira ma dame de Champaigne,
Celi cui damedex enseigne
Et espire de toz ses biens;
Si qu'en li ne faut nule riens.
Ainceis ja cui dire l'ose
I[un] pou trop d'une sole chose,
Tant hi mist cil qui la cria;
Largesce que trop (en) hia,
Largesce et li aus despens
Metent cusenson et espens
Mainte foiz ou gentil coraige.
Dex gart que ni oains[aions] domaige.
Lou jor de Noel au matin
Vos dit sainte eglise an latin
Lou saume que je vos comanz,
Metre lou vos veul an romant,
Si porrons prendre quenque soit,
Se folie ne nos decoit.

2

A costume et a chose usee
Tient chascuns rois an sa contree,
Cant il doit son fil marier
Ou il li vet fome doner:
Grant piece avant se fait savoir
Qu'il puisse a son besoingne avoir
Barons et prince et chasez,
Homages fiez et ligehez.
Chascuns des sergens se porvoit
De son servise an son endroit.
Jugleors font sonez noueauz,
Chansons et notes et faubleauz.
Que droiz est que chascuns s'atort
Contre la joie de lor cort.
Damedex, qui est rois et sire,
Fit autresi de son empire:
Ains que li veras rois venist,
Vot Dex que li sieglez sentist
L'odor de son avenemant.
Si fit naitre une sainte gent,

3

Cui il monstra par son plaisir
Ce qui estoit a avenir.
Les prophetes les apeloient
Li prodome qui lor vivoient,
Sainz homes et espiritez.
Des prophetes dit damedex
Que cil seroit si tesmoingn,
Por qu'il verroient de loig
Et nonceroient sa venue;
Par ce seroit la foiz crehue
Par ce que li saint home et saige
Vindrent avant comme messaige.
Fait sainte eglise les avans:
Si lut[lit] et chante les douz chans,
Qu'il mistrent an sainte escriture,
Qui dirra[durra]tant com siegle dure.
Trestuit ansamble s'acorderent;
A une voiz lou ban crierent:
Que li fiz deu viendroit a terre,
S'ennor et son raine querre;
Sires seroit de tot lou mont;
Jusques an enfer lou plus parfont
Descendroit il la droite voie,
L'en amanroit sa riche proie,
Les anchartrez et les chaitiz,
En la joie de paradiz.
Por vor seroit la proie grans:
Tuit li mort de. v mil ans
Que li siegles avoit dure
Seroient lors asseure;
For que sa part an retaindroit
Li deables qui remaindroit,
Li crual et li desloial
Qui avoient tot jors fait mal,
N'auroient ja nul reconfort
Sens repentir jusquez a la mort.
Ains seroient en sa baillie,
Se li faroient compaignie.
Si com recunte li escrit
.i. des prophetez fut David.
Ceste chanson que ja escrite
Trova il par saint esperite.
Puis fut il rois coronez
.M.ans ainceois que dex fut nez.
Si par offri il son servise

4

Es noces Deu et sainte eglise.
Bien sot que des ses heris seroit
La virge ou il s'aombreroit.
De ce n'ot il nule dotance
Ains hi mit tote s'esperance;
Que puis que Dex naistroit de mere,
Tuit serienz sereur et frere;
Sauriens part an l'aretege
Por qu'il facoit son pere ymaige;
Por vor bel homaige li fist,
Cant an forme d'ome se mist,
Et li douz peres voiremant
Li redona en chaucemant
Toz seoz qui sont de sa naissance,
Por qu'il aient droite creance.
Ceste pais et ceste devise
Prist nostre sire an sainte eglise.
Et il la redo[n]a a doble
Qu'il ne la do[n]a pas de moble,
Ains dona li et son linaige
La gloire Deu et l'eretaige;
Et ele promit damede
Vera amor et charite.
Ce saichiez bien que ce ne tient
Qu'a sainte eglise n'apartient.
Les nocent [noces] furent atornees
Par Gabriel l'ange nommees
An une chambre aute et bele:
Ce fut an la virge pucele.
Leans vestit nostre nature
Li rois de tote creature.
Ne plus que la virge sentit
Que Dex, qui onques ne mantit,
An son preciors cors se mist,
Et la voiz que li anges dist.
Ne sentit ele la naissance,
Cant damedex par sa puissance,
Qui ert en son benoit cors,
S'aparut antre nos sai fors;
Par ce li fit ele semblent
De gecine et d'acochement.
Que li Juif contralious
Et Herodes li envious,
Qui aparceuz s'en estoit,
Es monstrances que Dex facoit,

5

Li correust maintenant sore.
Mas encor n'estoit mie l'ore,
Que dex devoit la mort s'offrir
Por vos pechiez espeneir.
Cant David sot ceste novale,
Sa arpe prit et sa viole,
Si commance sa chancenote,
Qui mont est bele et sainte et note.
De latim l'a en romant traite
Au meauz qui pet cil qui l'a faite.
Oaint [devant] tuit bon clers dit il bien
Qu'il n'i a entrepris de rien,
Fors la endroit ou rime faut
Si met lou mot qui autant vaut.
Mas ains qui vaigne au commancier,
Vos contera por agencier
Commant Dex li mostra sa glore,
Si com j'a trove en l' estoire.
Ou fin cuer ou David estoit,
Qui en la cendre se seoit,
Et avoit la haire vestue,
Fort aspre ampres la char nue,
Comme penancier verais,
Li vint dever lou ciel .I. rais
Don la clarte suz li s' assist.
En cele clarte li aprist
Et ansoigne tot canqu' il sot,
Damadex qui faire lou pout.
En cele grant devocion,
Li sambla por avision
Que .I. anges vint par la fenestre,
Qui lou saisist par la main destre ;
Droit lou conduit, ce li fut vis,
A l'antree de paradis.
Mas la porte trova il close.
De ce est il certainne chose.
Que Dex hi avoit mis son ban
Des lou premier pechie d'Adan,
Que nuls n'i anteroit gimais
Jusquez cil en feroit la pais
Qui dou liniaige Adan viendroit,
Qui lou pechie sus lui prendroit.
Et sou[ce]convenoit estre tel,
Si saint et si esperitel,
Qui onques n'eust enteichie

6

Ne cuer ne cors de nul pechie.
He Dex! hons (tels) ou fu trovez,
Que si fust fins et esmarez?
Entre nos ne fut il pas pris,
Se Dex ne s'en fut antremis
Ni ai si fim ne si loiau
Ou il n'ait aucun pou de mau:
Par nos ne par nostre deserte
Ne fust gimais la porte overte ;
Ou siegle n'ai home si net
Qui defformest pas lou guichet.
Tant ai Dex fait que la porte ovre
Celui qui est pris en bone ovre.
Or fut David toz antrepris.
A cele porte l'ot assis
Li anges qui partiz s'en ere.
Mont velontex trovast menere
Qu'il se peust leans boter.
Lors commancai a escouter.
Mas la barre fut bien sarree
Et li anges tenoit l'espee,
Qui reflambeoit comme feus.
De l'efforcier n'estoit nul geuz.
Et cant David s'en aparceut
Toz quoiz se tint qui ne se mut.
Par ce qui n'osa apaler,
Si commansai a violer :
A la corde toiche l'arson,
S'en commansa ceste chanson.
Eructavit cor meum verbum bonum ;
Dico ego opera mea regi.
D'une dossour a plain lou cuer ;
Ne puiz soffrir n'en esse fuer.
Ma chanson veul dire lou roi,
Lou aut signor cui aim et croi.
Ancor est an sa chambre ancloz,
A son desduit, a son repos.
Sains esperiz, ovre moi hus :
Je chantera, s'antrer hi puis ;
Se li dirai .I. son novel.
Se li rois l'ot, mont li ert bel.
De cele part ou l'antree ere
Revint une voiz aute et fere
Qui li dit 'David, trai t'en sus :'
Garde que ni aprochier plus.

7

Li rois se desduit et repose.
Ne seroit pas secure chose,
A ton heus oir ne savoir,
Ce que hons charnez ne pet avoir,
Ne pet savoir nuls hons charnez
Quex est la joie esperitez.
Mas la chanson que tu veuz dire,
Escri la an chartre ou an cire
Et je ferai bien tant por toi ;
Que je la mostrerai lou roi
Se tu la baillez escrite,
Bien li serai mostree et dite :
Je li dirai ce que tu diz.
'Merci, sire,' ce dit David,
'Se je leanz antrez estoie
Avec les moz violeroie.
Juglerrez suiz saigez et duiz.
Se lou roi plaisoit mes desduiz,
Ce sai je bien que les sodees
Me seroient mont grans donees.'
Lingua mea calamus scribae,
Velociter scribentis.
'Ne dites pas que je l'escrive
La langue cui li cuer avive
L'escrira sans dois et sans mains,
Assez meuz que nuls escrivains.'
La vois respont 'Amis, bel frere,
Saichez por voir que nest de mere
Ne pet ceans matre lou pie,
Ains seront quite li pechie
Que tu es[as]fait et ti encestre.
Ni baier pas : ce ne pet estre.
[Tu te travailler por noiant.]'
David respont en soploiant,
'Merci, beal frere ; or ne vos griet,
Se ciz chaitiz a l'uis se siest :
Sai defors me co[n]vient atandre,
Cant je verra lou roi descendre.
Tost aura faite ma besoinne,
Se mes pechiez ne m'en esloigne.'
La voiz li dit, 'Trop demorriez,
Davi, se tant hi atandiez.
Atandre ne te vaudroit rien
Jusqu' au terme que tu sez bien :
Devant .VII. et .XIII. anz

8

N'istra li rois fors de ceanz.
Tu ne porroies tant soffrir.
Ains te coviendra a morir,
Ausi com tuit li autre font.
Si en iraz la ou il vont
En enfer ert t'arme saisie ;
Mas la ne remainra ele mie :
Cant mes sires li rois ira,
An enfer qu'il desconfira,
Et tu orraz sa douce vois.
Apres ce qui ert mis an crois
Avec les autres t'an vanras.
Bien sai que ja ni remaindras.
Or ser lou roi et si li proie
Qu'il t'an ramoint avec sa proie.'
Mont vient Davi a grant mervoille
De cele vois que li consoille ;
Noveauz consot dou cuer li muet.
Qu'or set il bien qu'antrer ni pet ;
Encor parole a son huissier,
Si lou commance a losaingier.
'Beau sire, .I. pou me conforte :
Por Deu, antrove moi la porte.
Si verra en cele charte
Commant li gloriouz filz De
Viendra por naissance novelle,
En la sainte dame pucele ;
Qui doit estre de mon lignaige,
Si com tu m'as mis en coraige.'
Cant David ot ce mot fine,
Soplemant ai lou chief cline
Jointes les mains en bas se tient
Estez vos qu' .I. grans escroiz vient
Et apres l'escrois espartit.
Mas la chartez n'en departit
Jusquez tant que li anges vint,
Qui por la destre main lou tin.
Si se leva sus des .II. piez,
Et cant David se fut dreciez
S'esgarda tout et descovert
Que Dex li ot son heus overt.
Ne je ne autres ne puis dire
La grant joie ou sez cuers se mire.
Bien nos quenoist et devis
La grant joie de paradis

9

Si en sai tant por l'escriture
Qui les doutances asseure.
Bien lou puiz dire sens mentir
Cil cui Dex l'a donee sentir;[1]
Que ou siegle n'est joie si grant
Qui vers celi na soit neant.
Leans furent totes portraites
Les noces que Dex ai or faites
Ou premier chief de sainte eglise,
Qui delez lou roi est assise.
Fut nostre dame coronee,
Cui nostre sires avoit donee
Sus toz l'enour et la corone,
Por ce qu'en sa digne persone
Avoit Dex lou siegle refait
Et a sa sainte gloire atrait.
Cil qui sauf furent et seront
Jusqu' al derrer jor dou mont
Li aparirent tuit devant,
Ausi com cil fussaint vivant;
Et David lez voit et escoute.
Mont par hi avoit bale rote.
Moyses nos dit et ensoigne
Que nuls ou siegle ne se feigne:
A bien faire soient tuit preu.
Or lou fassons, car lou vos leu.[2]
La letre nos dit et devise
Que jusqu'al jor dou grant joise
Ai Dex overte sa maison.
Car si qui ai senz et raison,
Qui jamais ni recevrera,
Qui jusqu'al lors ni entrera.
Damedex dit an l'avangile,
Ou il n'ai faucete ne guile,
Que lors sera la cort pleniere

1. In most Mss. there follow here these six lines, taken from the Madrid copy:
D'autre joie ne li souvient,
Tot a quant que il li covient;
Que nus ne li porroit aydier
A penser ne a souhaidier,
Ne rien ne porroit demander
Qui li seust conseil doner.

2 Kant nus ni puet prendre son lieu.
—Madrid Ms.
Si puet bien perdre son leu.
—Paris, Arsenal Library, Ms. 3518.

10

Et la joie fine et antiere.
Ce nos dit la letre et la glose:
C' apres si tient une [nule] autre chose.[1]
Leans en cele sainte gloire
Sera la joie et la baudoire,
Et cil qui remaindra defors
Aura perdu e arme et cors.
Qui en joie et en lioce,
N'est mervoille sor [se] il s'adrace
A faire ce qu' autre gent font.
David meisme s'en semont
De chanter et de faire joie.
Mont deserre que li rois l'oie.
La voile a faite et agence,
L'arcon a trait, les mos commance.
Lou roi l'ot premeremant,
Et puis la roine aussimant.
De chascun dit IX vers antiers
Et li rois l'ot mont velontiers.
Speciosus forma pre filiis hominum.
Precios rois, clere figure,
Beauz suz trestote creature,
A vos, sire, ne se prent nuls:
Beaus par defors et desans plus.
Et en cele beaute abite
La vertuz dou saint esperite.
Ce est lou temple Deu lou pere
Que por ce naistre vot de maire.
Beas sire et viendrez antre nos
Que Dex se mostrera en vos.
Diffusa est gratia in labiis tuis.
La vostre sainte bele boiche,
Don la vohiz ist qui les cuers toiche,
Plains de dossour et de grace,
Qui tot lou monde rassolace,
Issi puisse nos cuers toichier,
Que vers vos nos face aprochier.
Ce est la fontaigne et la doiz
De quoi sordra la sainte voiz,
Don sainte eglise ert replenie
Et conformee et estaublie.

1 Que apres ce iert la porte close.
—Rome, Vatican Library, Ms. 1682.

11

Propterea benedixit te Deus in eternum.
Por la bonte qui en vos est
Ne vos est pas donee aprest
L'onour et la beneissons
Qui est an vos e an vos nons.
Benois estes et serois
Suz quanquez vos beneirois,
Et ert beneissons anterine
Qui ja n'aura fin ne termine.
Et bele ert la senefiance:
Bien il devons avor creance,
[Quant li ange se monstreront,
Qui de la joie chanteront.][1]
Beas serois et sans totes taiche,
Lors que vos gerroiz an la croiche,
Cant la grant beaute ou vos estes
Aparcivront les mues bestes.
Vostre aparicion ert bele,
Cant l' estoille viendra novele;
Qui de si grant clarte luira,
Que les .III. rois en conduira
De la contree d' oriant
A vostre pie en Belleant.
Quant la verges, relievera,
Qui au temple vos offrera,
Bele ert cele processions
Ou mes sires, Sains Simeons,
Vos portera antre ses bras;
Si dira toz li solaz
Et la gloire du mont venue
Qui tant ai este atandue
Li baptoismes resera beaus,
Cant la [voiz] vos reviendra des ceaus,
Et Sains Jehans en tremblera
Qui suz lou chief vos versera.
Li bons batitres [a] en sa main
La sainte aigue dou flu Jordain.
An l'aigue antrera tel vertu,
Qui recevra vostre cors nu,
Qui puis en serai bautisiez
Lavez sera de toz pechiez.
Apres la aige de .XXX. anz
Sera vostre beatez mont granz,

12

Cant vos feroiz les mors revivre
Qui saudront suz sain et delivre
Meseauz, aveuglez, sorz et muz
Garroiz vos toz par vos vertuz.
Por suz la mer irois a pie
Si que ja ne l'aures moillie
Mont por seroiz beaz a la cene
Lou geudi la grant semeine,
Cant vos seroiz a vostre table.
Lou pain dou ciel esperitable
Recivront de vos li apostre.
La mendre part an sera vostre
Cant sainte eglise aura l'estraine
De vostre gent cors en demaine,
Qui ert sacrez antre nos mains
Mont sera preciors se pains
Ja ne faudra a vostre ahue
Lou jor qu'ele en sera pahue.
Mas la beate qui tot esclaire
Aurez vos an mont es Calvaire
La sacrerez vos lou servise
Qui puis ert faiz an sainte eglise.
La voire crois ert li autex
Ou recevra li pere Dex
De vostre bel cors l'offerande,
Por nos forfaiz feroiz l'amande,
Qui nos getera de prison
Et conduira a garison.
Totez les autres passera
La beautez qui en vos sera,
Cant vos viendroiz de mort a vie,
Que vostre char ert reflorie:
Ce est vostre robe novele,
Qui suz totez beate ert bele,
Lors aurez vos morte la mort
S'aurois pris et lie lou fort,
Lou deable, lou Pharaon,
Qui vostre gent tient en prison.
Qui vos delivrerez d'Egipte,
Si les ammanrois en melide.
Apres la resurrection
Seroiz beas a l'acension.
Cele beatez par est mont bele [clere],
Cant vos hiroiz a Deu lou pere.
Tuit li deciple lou verront,

1 Supplied from Paris and Madrid copies.

13

Qui as eauz vos convieront.
Tant com il pahuent esgarder plus
Vers la sainte gloire laissus.
Lai amont en cele contree
Hert des anges grant assanblee.
Mont hi sera la joie grans,
Et por defors et por dedans,
Cant cil dedans auront crie
'*Quis est iste rex glorie?*'
Cil respondront *cum gaudio*
'*Deus potens in prelio.*'
Ce est a dire tot sans faille :
'Li rois revient de la bataille.
Ostez la barre ; ouvrez la porte !
Anfers est pris ; la mors est morte !'
Accingere gladio tuo super femur tuum, potentissime.
Mont tarde David et demoire
Cil bons tens et cele bone hoire,
Qu'il voie lou jor acompli,
Que Dex ai leans estaubli.
Lou roi prie mont doucemant
Que ne demor pas longuemant.
Signor [ceigne] t'espee, qui si trainche,
Ampres lui sor sa sainte ainche.
Ce est la force qui doit estre
En la voiz [Deu] et en sa destre.
A ces vers ci fait bon entendre,
Qui talant ai de bien aprendre,
Quant vient au chanter e au lere,
Que pechierres vet ces vers dire.
Suz totes riens doit reclamer
Lou roi qui tant fait e amer
Que cele soe sainte espee,
Devant cui pechiez n'a duree,
Vaigne departir les pechiez
Don li pechierres est antaichiez.
Si est antaichiez d'avarice,
Qu'il ait talant de malvais vice,
La vertu Deu lou mate jus,
Que sus lui n'en remaine plus.
Et si li face amer plus haut
La grant richace qui ne faut.
S'il est sorpris por avanture
D'aucune malvaise luxure,

14

Cele sainte espee trainchanz
Descende jusques ou cuer dedanz.
Si li departe cele flainne
Qui dou cors muet si prant aleine
De quelques amor qui soit sopris,
L'amour Deu ait anme lou vis.
Si croie bien toz jors les los,
Que dit li apostres Sains Pouz,
Queques li cors d'aute amor face,
Gart se bien que li cuers lou hace.
Tost pet malvaise amor estaindre,
L'amor Deu por qu'els soit graindre,
Se pechierre ai ou cuer corine,
Qui trait home a mortel haine.
Reclamer Deu et prier doit
Que cele espee li envoit,
Qui li roie jus et defface
Que jamais son prusme n'en hace.
Li rois dit '*Michi vindictam : Ego sum qui retribuam.*'
Ce nos ansoigne sanz dotance
Que sor lui laissons la vaingence ;
Ja au pecheor n'en souainne.
Sor lui la laist bien l'en covainne.
Qui bien pense a son creatour
Qui tant soffri deshonour,
Que onques ne s'en vot revaingier
Bien an de[v]roit son cuer changier.
Specie tua et pulchritudine tua.
Bien ot David lou roi covant
Mont lou prie et loe sovant ;
De .II. grans beautez lou renome.
L'une ce est nature d'ome,
Qui en lui est si chere et fine
Que toz li mondes li encline.
Que beatez d'ome est en lui tote
Si que de pechie n'i a gote.
L'autre cele qui de Deu naist,
Qui les anges sostient et paist,
Les sains et les saintes norist,
La grant doçor qui de lui ist,
Cui Dex la done aparcevoir.
Bien lou vos puis dire, por voir,
Li deliz et la soatume
Anprent si son cuer e alume,

15

Que jamais ne s'en querroit mueure
Neis tant com .I. eauz clot et ovre.
Por avoir .M. an a devise
Tot lou joie que siegle prise.
Intende, prospere, procede et regna.
David ot sa loseigne traite
Por avoir sa besoigne faite.
Plus an seroit ses cuers a aise,
Lou roi prie mont qui li plaise.
Qu' un sol petit a lui entende
'Sire, fait il, 'mont vos demande
Li siegles et la gent menue.
Tuit deserrent vostre venue.
Bien est maiz droiz que vos vainnez
E issiez fors, sire, si regniez.
Nos qui vostre messaiges somez
Avons semons anges et homes,
Soloil et lune, terre et mer,
Et tot lou mont de vos loer.
Vos creatures vos atandent.
Mont vos covoitent et demandent,
Nes les estoilles, qui cler lusent,
A vos beneir se desdusent.
Sire, si vos vient a plaisir,
Bien poez mais sai fors issir.
Si dirons, Dex soit antre nos,
Vostre merci si seroiz vos.'
Propter veritatem et mansuetudinem et justitiam: et deducet te mirabiliter dextera tua.
Si remantoit David lou roi
.III. costumes qu'il ai en soi.
L'une est ce qu' en voir dit se tient
Quiques soit rois bien li avient.
Que ses covans soit veritables,
Ne doit estre vains ne muables;
Ne doit amer ne consantir
Celui qui li loe a mantir.
L'autre, que douz est et pideus,
Bien hi avenent ambedeus
Mont sont la menue gent lie,
Cant lor princes ai d'els pitie;
Mont les refait e asouaige
Ce que lor sire les sorglaize.
Apres vient li tierce bontez:

16

Ce est justise et beautez.
La justise espurge la terre
Et defant de malvaise guerre;
Ne suefre pas grever atort
Lou foible ne que lou plus fort.
La ou droit et justise dure
Est la terre sauve et segure.
Por ce fait soi David 'Beau sire,'
Poons nos segurement dire
Que de .III. beatez estes beauz:
Vor disanz, pideus et leauz.
[Cels nos feront acheminer,
Les ciel ouvrir et encliner,
Por vos descendre et abessier
Que vos nel porriez lessier][1]
Pieçai que promis nos avez,
Si com vos meismes lou savez,
Que vostre siegle sauveroiz
Et vos sanz faille si feroiz
Vostre lactre [chartre] et vostre seel.
En orent li fil Israel,
Cant vos escreistes la loi
An Mont Sinay ou vostre doi.
De quant que vos avez mis ans
Vos en seroiz bien voir disans.
Ja nou lairoiz por vos pechiez:
Vostre autre teche est pitiez,
Qui vos an fait resovenir.
Ne vos en porriez tenir.
Toz jors avez une costume,
Qui nos cuers garit et ralume.
A quoi vostre plaisir s'acorde,
De pecheor misericorde.
Pechie n'amez vos por nature;
Que vostre clartez est si pure
Que malvaitie ne vos puet plaire,
Mas qui lou pechie laisse a faire,
Por qu'il ait bon repentemant
Prier vos puet segurement.
Et celui qui se trait en sus,
Ce est cil que vos haez plus.
Por ce voles que se repente.

1. These four lines wanting; supplied as found in Paris, Nat'l Library, Ms. 24,429.

17

Que pardoner vos a talante.
Sire, vostre tierce maniere
Ramende mont nostre priere ;
Qui ne puet estre a nule guise
Que vos ne resinseiz [1] justise.
Nos qui pieçai vos atandons,
La justise vos demandons,
Si prions que il la nos atort
Au jugement de vostre cort.
Dou deable qui nos sormeine,
Qui nos pecheors met en peine,
Premiers lez loseinge e atrait,
Quant li hons ai lou peche fait.
Et il lou tient en son landon
Sel mene en enfer abandon.
Sire, malvaisement vos sert :
Ce doit pas estre soffert ;
Tel outraige ni ai il mie,
Son pooir et sa soignerie.
De[v]roit bien perdre tot adroit
Cil qui an fait plus qui ne doit.
Por ce creons nos tot devoir
Que vos li todroiz son pooir,
E abaisseroz sa malice
Par lou droit de vostre justice.
Sagittae tuae acutae, populi snb te cadent, in corda inimicorum regis.
David ot parle de l'espee,
Qui fut trainchanz e afilee ;
Mas des seotes esmolues,
Que li rois ot au le[z] pendues,
Et de l'arc qu'i[l] tenoit tandu,
A il a parler entendu.
Por ce vos anseigne an cest vers
Quex est la floiche et quex li fers,
Et que la corde senefie.
S'est bien raisons que lou vos die.
Li fuz de l'arc fut la viez lois
Que nos li puissans dona rois.
Mont lou chapusai roide et fort

18

Et mist que qui feroit tort.
Mont durement lou comparroit,
Ja nule riens ne l'an garroit,
Et qui pecheroit laidemant,[1]
Occiz seroit isnelemant.[2]
A cel arc prist Dex la justise
Ainceis que la corde hi fust mise.
Batuz et roilliez en estoit
Qui a mal faire s'arestoit.
Mas por ce que la loiz fu dure,
Et li rois n'ot de durte cure,
Si se pensai que il feroit
Tel chose qui la douceroit.
Car li ars ne vaudroit neant
S'il nou façoit doux et pleant.
Li ars estoit durz et pesanz
Et la main Dou fort et puissant.
Si vossit a une colee,
Eust il sa gent afolee.
Ne li sembla pas avenant
Qu'il an ferest de maintenant.
Li douz sires, li debonaires,
Por ce qu'il an vot soef traire,
Et qu'il ama pais e acorde,
Plehia son arc, si mist la corde.
Por ce li mit en sa persone
Li rois qui les autres biens done.
La sainte evangile qui dist,
Ce fut la corde qui hi mist,
Qui la loi fait vers lui ploier
Por les sahiotez anvoier.
La loi façoit justise et droit,
De nule rien ne se laichoit.
L'avangile nostre soignour
Fut de petie et de dossour.
Il fut justiserres et pidouz ;
Si se sot bien aidier dandouz,
Justise vers pidie ploia.
Carreas et dars nos anvoia,
Tel qui bien furent agusie

1. The word cannot be identified, but is meant probably for a form of REFAIRE. Other copies have REFACIEZ, REFASSEZ, or REFACHIEZ.

1. Paris, Arsenal Library, Ms. 3518, has DUREMENT.
2. Above Ms. has SANS JUGEMENT.

19

Et de justise et de pidie.
Li apostre qui Deu oirent,
Et li deciple qui l'oirent,[1]
Sont les seotes qu'il anvoie,
Et la penne qui les convoie ;
Saint Esperite qui les meine
Qui lor done force e aloine.
Li fers de la floiche qui vole,
Ce est la voiz et la parole
Que Dex anvoie por ses sers.
Mont soez est et douz li fers,
Qui si perce lou cuer dou ventre,
Que nuls ne set cant il entre.
Buer est nez cui li fers ataint :
C'est li couz don nuls ne se plaint ;
Qui navre d'amor et de foi
Ces cuers as anemis lou roi.
Mont devrient avoir l'arc chier,
Et mont devons amer l'archier,
Que si nos navre doucemant.
Qu'il nos atrait a sauvemant.
Li rois se mist an mi lou monde,
Tot antor trait a la roonde,
Por aenplir sa verite.
De Jherusalem la cite
Envoia seotes et dars
Qui volerent de totes pars.
Mont fut la seote ardie
Que li rois trait vers Lombardie :
Ce fut Sains Peres tot premiers
Que si fut coraigeors et fiers.
Dedans Rome se bota
Que roi ne comte ne dota,
Por ce que l'ennor et la some
De l'autoce estoit a Rome,
Li bons archiers s'en avança,
Une autre seote lança :
L'apostre mon signor Sain Pou[l]
Qui vint a Rome de plain voul.
Ha Dex, qu'il furent cil .II. dart,
Et com lou fit por bel esgart,
Cil hui[qui] les ot an son tarquais !
Cil qui porterent plus grant fais,

1. Other Mss. read LE VIRENT.

20

Et endurerent les durs quouz,
Ce fut Sain Peres et Sain Pouz.
Bien durent signor de Rome estre
Li .II. apostre, li .II. mestre
Qui de paradis ot les clers.
Tant ai por aux fait damedex,
Que la ou deables regnoit,
Qui lou siegle sor lui tenoit,
Et pormenoit en son lien,
Sont deslie li crestien.
Li bons archiers que si loint lance
Retrait .II. seotes an France,
Bien legerez et bien trainchans,
Qui s'arestirent droit a Sans ;
La estoit toz li bofoiz
Et li chief des Sarredinois.[1]
Li .I. fut Sains Sauveniens,
Li autres Sains Potenciens,
Selonc lor nons la vertu orent ;
Cambedui sorent mont et porrent.
Des deciples damedeu furent :
Avec lui maingerent et burent.
Par ces .II. fut France conquise.
A Sans fut la premere eglise,
Qui ai non Sain Peres li Vis ;
C'ancor n'estoit Sains Peres occis,
Cant cele eglise fut fondee,
Qui de son non est honoree.
Des autres seotes volans
Ne fut pas li archiers trop lans.
Il vit par tot et par tot trait ;
Des oriant ou solois naist
Outre Illande[2] ou il sa cote
Fut conquise la terre tote.
Sains Jaques maintint a sa vie
Tote la terre de Sulie.
Sains Jehans convertit les Grex
Si fit eglises e autex :
Par lui laissa Grece s'ereur
Et reconut son creatour.
Sains Andriers ot Eschavonie[3]

1. In other copies SARRAZINOIS.
2. JUSQU' EN IRLANDE, DUSQU'EN ISLANDE are found in other copies.
3. ESCLAVONIE in other copies.

21

Et la terre de Romenie.
Sain Thomaz fut plus avanciez;
Que jusques an Ynde fut lanciez:
O il ala por merci aiant, [1]
Si convertit tote la gent
Qui point de creance n'avoient,
Et qui de Deu riens ne savoient.
An l'autre Ynde la plus lointene
Ot Sain Berthelemex grant pene.
Sain Phelipez par sa merite
Conquit la terre vers Egipte.
Amont Arabe et en Perce.
Ou la sauvage gent-converse,
Fut Sains Judas et Sains Simons.
La traist li rois ces .II. barons,
Qui an pou d'ore orent conquis
Jusquez an Ynde tot lou pahis.
Sain Mars fit la loi Deu antandre,
Au puple d'antor Alixandre
Sain Mathis conquist Moretene:
Par tot leva li rois sen soigne.
La outre est li grans biens
Et la loi Deu es Crestiens;
[Dont la novele est miex[meins] certainne
Por ce que la terre est loingtainne,][2]
Deables qui lou bien abaisse
Par la androit ou Dex li laisse.[3]
Ai antre douz .I. mur leve
Par quoi Cretien sont greve.
Cele forterace et cil murs,
Ce est li linaiges des Turs;
Qui an commance outre la coine
Si an vient droit por Babiloine,

1. O il ana par mer naiant
—Paris, Nat'l Library, Ms. 1747.

2 Supplied from Paris, Natl. Library Ms. 24,429.

3. Paris. Sainte Genevieve Library, Ms. L.f.13, reads these two lines as follows:
'De Sesile qui tot le bien abesse
Par tot les liex ou Diex li lesse
The latter line is thus given in the Madrid and Vatican copies, but the Sainte Genevieve Ms. is alone in beginning the preceding one with 'De sesile.'

22

Jusques an Espaigne contraval;
Tant hi a Dex laissie de mal,
Et tant hi ert com Deu plaire.
Ne savons cant il hi traira.
Ce saichent bien tuit Cretien:
Maint mal soufrit por nostre bien.
Dex comandai, n'an dotez mie,
De Juif que nuls nes occie.
Ains les laissons antre nos vivre,
Por ce c'an lor loi sont li livre
De nostre foi et li tesmoig
A quoi vos alons au besoig.
Autel poons des Turs dire:
Por ce les soffre nostre sire,
Que aus poons nos aparçoivre,[1]
De quel vie[2] uos somes seiure,
Et com grant bien Dex nos ai fait
Que des Turs somes nos estrait.
De tel liu nos ai apele
Damedex, qui a revele
Son fil lou roi esperitable,
Qui nos trait des mains au deable.
[Bien sont, merci Deu, avanceis
Las saites qu'il a lanceies:][3]
Bien ai fait ce qu'il vot faire
Vers nos ai trait por nos atraire.
Es sains dona li larges sire
A toz corone de martire;
Et il lou tindrent a grant don,
Lor cors livrerent abandon.
Ne lor chaloit bien lou vandoient
A la joie qu'il atandoient;
Ni ot celui qui eust cure
De joie qui gaire ne dure.
Que cil qui les façoit atandre
Pooit bien l'atandue randre.

1 Qu' a eus nos poom aperceure Paris, Natl. Library, Ms. 1747.

2 Paris, Natl. Library, Ms. 24,429 reads 'vice'; Ms. 1747, 'vilte', as also the Vatican copy; the Madrid copy begins the line 'De quoi vivre.'

3. Found as here given in all other Mss. Supplied from Ms. 1747, Natl. Library, Paris.

23

Sedes tua, Deus, in seculum seculi;
Virga directionis virga regni tui.
Des saietez vos ai conte,
Grant partie de lor bonte.
Or escoutez que cez vers dist
Dou riche trone ou li rois sist,
Et de son septre qui tenoit,
Si beal com a lui avenoit.
Li trones sist sus .IIII. piez.
Si fut fors et si estaichiez
Que rien ne lou peust mouoir
Por peine ne por estevoir.
Se ciel et terre et mer tramblast,
Ja li trones ne se crolast;
Si fermemant estoit assis
Ou plus beal lui de paradis.
.IIII. barons de grant valour,
Qui bien furent de lor signour,
Purent sors lou trone atire;
Si enbraçai chascuns .I. pie.
Cil portent lou roi et sostenent
Et avec lui vont tuit et venent.
S'en ai chascuns tel chacemant
Qui ne faut a rien qui demaut;
.I. des chasez fut Ysaies;
Li autres Sains Jheremies;
Li tiers avait nom Daniel;
Li quars fut Isechiel:
.IIII. bestes qui a les hont
Furent es .IIII. cors amont,
Et selonc la senefiance
Ot chascune vie et semblance:
Ce sont li .IIII. evangeliste;
Si tenoit chascun d'auz son tiste.
A seos de soz font grant haie.
Sain Matheux fut sor Ysaie,
Si ot d'ome vis et figure;
Por ce que l'umaine nature,
Que li rois prist en la pucele,
Don Ysaias dest la novele,
Grant piece ainceois qu'il avenist,
Sit[1] Sains Matheux et si l'escrit.
Ysaies vit en la flor

1. Other copies have SI VIT, or VINT.

24

L'avenement nostre signour.
Sain Matheux an ot lou desduit,
Qui de la flour cuillit lou fruit
Et se vit la flor espannie
An ma dame Sainte Marie.
Cist .II. l'unes des quepouz portoient.
Por ce qu'ensemble s'acordoient
[A escrivre la verite
De la sainte nativite.][1]
De l'autre part a l'autre cor
Ot une semblence de tor.
Sain Luc sist sor Sain Jeremie.
Sorrois que li torel senefie:
Cant an la mer lor avenoit[2]
Que toz li puples mesprenoit,
[Que par bruit ou par aventure
Fessoient aucun mespresture,][3]
Faire l'en convenoit l'amande;
Si amenoit en offerende
[Cil dui home lor fais portoient
Mont doucement le soustenoient.][4]
Au temple Deu en sacrefice
.I. torel ou une genice.
Por lou torel sacrifie
Estoient quite dou pechie.
Sain Jeremies vivoit lors
Si lor disoit bien que li tors
Estoit une senefiance,
[Ni eussent il sa fiance][5]
Si lor denonsai propremant
Lou verai sacrefiemant,
Que damedex li rois feroit,
Qui tot lou monde espurgeroit.
Si com Jeremies hot dit
Et Sain Lucas lou sot et vit,
Que damedex acompli l'ot
Si lou nos escrit mot et [a] mot.

1 Supplied. Found in all other copies
2. Quant en la viez loi avenoit. Madrid Ms.
3 Supplied. Found in all other copies.
4. " " " " " "
5. " " " " " "

25

De ce fut la vangile sainte :[1]
Ni ot rien trouee ne fainte.
Por ce est bone la campaignie
De Sain Luc et de Jeremie ;
Que Jeremies fut li hons
Qui plus dist de la paission,
Et Sain Luc cil qui meuz l'escrit
Si propremant com Dex lou fit.
Et por ce avoient visaige[2]
[Vost Dex qu'il eust visage]
Et lou semblent de cele beste
Don li Juif[3] façoient feste.
Cil qui valent .I pou entendre
A Sain Luc poient il aprendre
Que por lou sacremant lou roi
Est trespassez cil de lor loi.
Sain Marc fut a .I. cor derrier,[4]
Qui ot une ardie chiere.
Et .I. senblent de lioncel
Si estoit sor Saint Daniel.
Daniel si com nos lisons[5]
Fut getez ou lac es lions.
Li larron com [qu'on] devoit lors
Occerre e afoler des cors,
A cez lions livrez estoient,
Qui maintenant les devoroient.
Quant il virent Sain Daniel
Si furent simple com aignel.
Antr'oux[6] fut tote une semainne,
Qu' onques ni ot ne mal peine,

1. This and the following line found only here and in Paris, Nat'l Lib'y, Ms. 1747.

2. E por eel ancian usatge.
—Paris, Nat'l Library, Ms. 1747.

3. 'Li Jueu,' 'Li Gieu,' 'Li Jui' in Ms. 1747, Nat'l Library, and 3518, Arsenal Library, Paris, and in Madrid copy respectively.

4. 'Au chief deesrin,' Paris, Ste. Genevieve Library, L. f., 13 ; 'a un chief deriere, Madrid Ms.

5. This line and the six following are not found in Ms. 2094, Nat'l Library, and in Ms. L. f. 13, Ste. Genevieve Library, Paris.

6. This phrase appears differently in various copies : 'Antr' els,' 'Antr' eus,' 'Entr' uz,' 'Entr' euls,' 'Entr' aus,' 'Antr' aus,' 'Entre eiex.'

26

Ains s'an issi sauz et sains.
Si lou traist li rois de ses mains ;
Et maintenant qui l'an n'ot trait
Ceos par cui il li ot ce fait,
Fit leans trabuchier et motre,
Si com vos reconte la lotre.
Ni ont gaires demore,
Cant il furent tuit devore.
Ceste avanture qui avint
A grinor[1] chose apartint :
Sain Daniel senefia
Nostre signor qui tot crea,
Cui li Juif contralierent.
Por vor destrure lou cuidarent,
Et en enfer s'arme livrer
Es deables por devorer.
Mas Dex li peres l'en geta,
Qui de mort lou resucita.
Et ceos cui il ot en ahiz,
Par cui lor sires estoit trahiz,
Mist enenfer ou plus parfont,
Ou lac ou li deables sont.
Ce sont li lion qui devorent
Toz ceos qui avec aus demorent.
Daniel por ceste avanture
Et por les mos de l'escriture
Tesmoine la resurection ;
Et Sain Mars au vis de lion
Li aide a porter lou roi.
Si vos dira la raison porquoi.
Nos trovons, et est veritez,[2]
Que, cant li lionceaus est nez,
Qu'il n'ai en lui fum ne aloine.
Ne li bat point pouz ne voine ;
Ain se git mors jusquez tier jor,
Lor li vient li peres entor ;
Et quant il l'ai son tor fait,
Si s'areste, si giete .I. brait
Suz son faon qui trove mort ;
Por ce qui brait et crie fort,
Si en avient une mervoille :

1. Madrid Ms. reads, 'mont grant ; Paris, Arsenal Library, Ms. 3518, 'molt tres grant.'

2. 'Et voirs [vers] est provez' in all other copies.

27

A la voiz qui ot aute et clere
Si requenoit et sent son pere.
  Dex qui est suz tote nature
Vot que Sain Mars ahut[eust] figure
Et de lion gere ardie,
C'an lui n'ot point de coardie.
Sains Esperis li consoilla
Commant li fiz Deu s'esvoilla;
En la vangile lou meist
Si quez de rien ne mesprist;
N'i a celui qui meas vos die
Commant vint Dex de mort a vie.
Sain Daniel, qui lou vit ains,
Redut estre bien ses compains:
Mont se sorent bien antraidier.
Si .II. au trone menoier
Sovavent portent lor signor.
Mas apres sont li .II. grinour.
  L'autre que pou darrier acole,
Une grant aigue [aigle] qui aut vole,
Ce fut mes sires Sain Jehans.
Cil vit par tot et fors et ans;
Suz toz les autres vole an aut,
La endroit ou li cuers lor faut
Et la clartez les esbloist.[1]
Vot nostre sire qu'il veist
Et entendest plus autemant
Ce qu' il est senz commancement;
Et ses reaumes est sen fim,
N'i a ne vespre ne matim,
Qui n'a en lui chose muable:
Tot est seur; tot est durable.
Sains Jehans qui ce nos contai
Fut aigle que si aut montai.
Si ot li rois aut consoillier;
Mont li prestai riche aroillier
A la cene ou il cena,
Cant suz son piz son chief china,
Mont ot cel ore beal repoz,
Que toz li mons estoit encloz
An ce aroillier qu'il avoit:
C'est ou piz Deu qui tot savoit.

1. 'Esbahist' in Madrid copy and in several others.

28

Bien dut la nuit dormir sover,
Cant a son chevot ot la cler [clef],
Qui la glore Deu li ovri
Et son tresor li descouri.
Sains Esperis qui nos enseigne,
Qui si belemant acompaigne
Lou viez prophete et lou novel,
Nos mostre an [que] Jezechiel
Et sains Jehans ensemble sont;
Qu' embedui gardent contramont.[1]
Si sont plus prez dou roi a destre,
[Icist dui noncierent tot l'estre][2]
Deu regne Deu et de sa gloire.
Si lou nos mostrent an memoire.
Ce sont li .II. qui plus aut volent,
Qui plus parfondement parolent;
Qu'en romant ne poons escrire
Si com nos lou trovons an livre
  Conte vos ai, si com je dui,
Commant cil baron .II. et .II.
Portent lou roi qu'en nos creons.
Or entendons et si veons,
Por nos armes reconforter,
Commant li rois se fait porter.
Li rois se siet an sainte eglise,
Que jusquez au jor dou grant ivise
Se vet deporter et esbatre.
Cil prophete, qui furent .IIII.,
Sont cil qui avant lou noncerent;
Et li .IIII. qui lor aidarent
Sont cil qui l'avangile firent,
Si propremant com il lou virent;
Et poiserent en lor fontene.
En la boiche lou roi demaine.
Cil .IIII. et .IIII. ce sont .VIII.;
Mont bel servise li font tuit:
Lou roi desduisent et deportent.
De siegle en siegle lou deportent;
Savoir lou firrent et feront

1. All other copies read thus, except Paris, Natl. Library, Ms. 24,429, which has, Qui Dieu gardent en contremont.

2. Supplied from Paris, Natl. Library, Ms. 24,429. Rome, Vatican copy, reads 'mostrerent tost.'

29

A ceos qui urent et seront.
L'avangile lou nos ensegne.
Cant tot li pueples Deu s'enseigne
Dou signe de la sauvete,
Par quoi nos somes rachete.
Dou roi nos font aparcevoir,
Se nos lou volons recevoir.
Saiche qui les at par defuer,
Si ne les laisse antrer ou cuer,
Et condure lou roi laeans
Que li oirs est finz neans.[1]
A nule fin ne puet oir
Cil qui n'en fait mas que l'oir,
Qui maintenant ai oblie
Celui qui l'a fait et cree.
[Ce sachez bien que l'armas morte][2]
Qui encontre li clot la porte ;
Que l'arme qui a Deu ne pense
Ne pet avoir nule deffense ;
Nestre ne pet a nule guise
Que dou pechie ne soit sorprise.
Mas cele arme est bien ahuree,[3]
Et de tot bien asseuree.
Qui son signor reçoit a joie
Et qui deserre qu'ele l'oie.
Nuls enemis ne lou deçoit ;
Pechier pet il a la foie,
Mas puisqu' a bien est avoie
Et Dex la reçoit an sa grace,
Ses enemis confont et chace,
Cant il revient si les depart ;
Qu' aprochier n'osent cele part.
Bien en doit l'arme sovenir :
Tel oste fait bon retenir.
Li beal ceptres que li rois tient,
C'est la justice qu'il maintient :
Se nos mostre senefience.
Confession et penetance,
C'est la verge qui vos adrace,

30

Qui por amor et por destrece
Nos fait au sentier assener
Par ou li rois vos doit mener.
Nos veons avenir sovant
Que li peres bat son anfant ;
De la verge lou chastie
Cant il li voit faire folie.
Por ce si lou bat et destraint
Si n'est il rien que il tant aint,
Ne qu'il ait ou siegle si chiere.
Et nostre sire en tel menere
Nos chastie comme bon pere.
Se la penitance est amere,
Soffrir devons e andurer
Por nos armes asseurer,
Por la peine qui .I. pou dure
Fait Dex l'arme sauve et segure ;
Qui ne vet que chose hi remainne
Par quoi deables nos sorpreigne.
Dilexisti justitiam, et odisti iniquitatem ; propterea unxit te Deus, Deus tuus, oleo laetitiae prae consortibus tuis.
Ciz vers parole autemant
De l'onor dou coronemant.
Une raison vet com [qu'on] entende
Que li Juif quiert et demande
Commant li fiz Deu vot venir
Por son reaume maintenir.
Se lui pleust autre menere,
Li sires qui si puissans ere,
Ou ange ou home hi anvoiast
Qui de par lui nos anonceast,
Se commandast par sa parole.
Saichiez que tel demande est fole.
L'escriture nos en garist :
David li rois vos en escrit.
Une raison qui mont est droite ;
Qui lealte aime et covoite,
Qui heit pechie et felenie
Bien doit avor aute baillie ;
E aut onor doit on atraire
Tel qui pooir ait de bien faire.
Li fiz Deu sus tote rien
Aime canquez partièn̂t a bien.
Qui felenie et mal feroit

1. This and preceding line lacking in Madrid copy and in Paris, Ste. Genevieve, Ms. L. f 31.

2. Supplied from Ms. 1747, Natl. Library, Paris.

3. Mais cele ame est bone euree, Paris, Arsenal Library, Ms. 3518.

31

Sus tote rien le desplairoit.
Et por ce qu'il ot lou voloir
De tot bien faire et lou pooir
Li fut adroi li donz donez,
Que suz toz fust rois coronez,
Que ange ne home ni eust
Qui tant poist ne tant seust.
De ce dit David et devise,
Sire, qui tant ames justise ;
Vos n' avez cure de malvaitie
De felenie, velain pechie,
[Molt par nos ere grans besongs
Que vos fussez deu roi enongs.]
Dex qui vos emplit de sa grace,
Vos enoint lou chief et la face
Dou bel cresme Saint Esperite,
Qui afiert a nostre merite.
Jhesu Chriz ane estez nomez :
Ce est sauverres ancresmez,
Que vostre siegle sauveroiz ;
Et rois coronez en seroiz ;
Rois de joie et de liece,
Sen fin, sen duel et sen tristece.
Mirra, et gutta, et cassia a vestimentis tuis, a domibus eburneis: ex quibus delectaverunt te filiae regum in honore tuo.
Si parole sainte escriture
De cele riche vestuhure,
Que Sains Esperites tailla ;
Qui la reine la bailla.
Et ele an ot vestu lou roi
An sa chembre tot an requoi
Entre lui et Saint Esperit
Si coiement que nuls nou vit.
Cele robe deliciose,
Ce fut cele char preciose
Que li rois prist an nostre dame,
Qui fut sainte an cors (et) an arme.
En la robe ce aut seignor
Sent David une fine odour :
De la vertu Deu qui claire
Vient cele odor qui soef flaire ;
Si semble qu'il an sorde et naisse
Mirre, aloe, basme et caisse.
Cele douçor que David sent

32

Recevient en lui de pimant,
Portot e aval e amont
Les armes qui es nosses sont.
La mirre, que li flaire fort,
Senefie la nostre mort,
Que Jhesu Criz li roiz soffrit
En nostre forme qui vestit.
N'i a prophete qui ne die
Que sa mort nos randit la vie.
De la mirre et de l'aloe
Et[ot] li rois lou cors conroe
Cant il vi[n]t ou sepulcre mors,
Mont fut lou jor li pimans [fors],
De quoi sainte eglise est plains.
Sain Jehans et li Maseloine,
Qui la primere odour sentirent,
Leamant la nos departirent.
Li bames mostre l'onction
De la sainte surretion.
A ce jor fut li rois sacrez,
Benois e anbausemez ;
Lou jor fut li pimanz soef.
Bone part en fit damedex
A ses apostres qui an burent,
C'après la mort lou reconurent.
La soatume de sa gloire
Lor mit en cuer et en memoire.
Et Sain Thomas, qui en dota,
Enz ou pimant sa main bota.
Cant il atoicha au coste
Don Longins ot lou fer oste.
La cause qui primers florist
C'est .i. fuiz que l'aigue norrist :
Si nos senefie en[et] anseigne
[La voire croiz, la haute enseigne][1]
Que tel pooir ai ou batesme,
Ou cele est faite dou sain cresme.
Que li aigue antrait a lui tel force
Que des pecheiz abat l'escorce.
Des vestemant lou roi descendent
Ces odor qui loint s'espendent.
Bien devroit l'arme demorer
Au sentir et au laborer.

1. Supplied from Madrid copy.

33

Qui est cils sires qui tant l'eime,
Qui sa doucor amie la cleime ;
Que, por li aidier au secors,
Vest morir por fines amors?
David dit que por ceste odor
Serviront lou roi a honor,
Filles au roi, dames, pucelles ;
Que por ce les fait li rois beles,
Qui an vest estre bien servis,
Cant lor bel cuers est ses deliz.
Quant gentis cuers a Deu s'adrace
Lors est doble la gentiloce.
Qui est de Deu et Deu lou rent,
Cant il fait lou bien aparant ;
Vilains cuers redevient gentis
Cant il est a Deu ententis ;
Et li cortoiz avilenist
Si tost com vilonie en ist.
Mas non por ce grant avantaige,
Cil cui Dex auce en aut paraige,
Cui il done force et puissance,
Senz et raison et conoissance.
Que damedex qui lou crea,
Et plus i met et plus hi a,
Bien se doivent estre garde
Cil qui pooir hont de par De :
Li baron, li prince et li roi,
Qui metent lou siegle an effroi.
Car se ce que Deu plaist n'est fait,
Qui plus i puet plus i mesfait.
Salemons li rois vos escrit
.I. sens que damedex ou cuer li mit.
Vos fait il qui terre tenez ;
Entendez moi, si aprenez :
Vie d' ome est si abregie
Que ce n'est mas une sargie.
Se Dex nos ai preste cest soir
Sa soignerie et son pooir,
Por lou bien qui nos ai preste
Poez avoir tot conqueste ;
Que nostre amor sera muee
Qu' a toz jors mais sera duree.
Amez Deu et justise et pais ;
Si regneroiz a toz jors mais :
Si tiendrez lors a droit conquest

34

Ce que vos est baillie aprest.
Abstitit regina a dexteris tuis in vestitu de aurato : circumdata varietate.
David ot dit de l'armeure
Et de la riche vestihure :
[Ke Saint Esperites tailla,
Ke la roinne li bailla][1]
Des commandemans et de lois
Et des beautez lou roi des rois.
Si parole de la roine,
Qui delez lui estoit ancline,
Clere et bele et bien atornee,
Tot autresi com la jornee
Qui devant lou soloi se lieve,
Et com l'aube qui main crieve.
Vestu ot beauz atornemans ;
N'est richace ne paremans ;
Que nuls cuers saiche deviser,
Que l'en ni peust aviser ;
D'or ne de perre preciose
N'est nule ovre si graciose
Qu'en celi ne soit batarde.
Li rois d'un douz esgart l'esgarde,
Qui tote l' esprent et avive.
Cele est en lui si ententive
Que riens ou siegle ne li plait
Fors de la doucor qui de li nait ;
Et lou roi riens tant n'a[m]beli
Com fait l'amor qui vient de li.
Cant David voit cele mervoille,
Cel joie que Dex aparoille,
Si se porpanse qui fera :
De la reine chantera ;
Si la loera en chantant,
Qu' a cele joie qu'ele atant
Formement se taine e arde ;
Bien se gart qu'ele ne la parde,
Que gimaiz an tot son eaige
Ne recovreroit lou domaige.[2]
Audi filia, et vide, et inclina aurem tuam : et obliviscere populum tuum, et domum patris tui.

1. Supplied from Madrid copy.

2. Ne rechevroit mes le damage. —Madrid copy.

35

David, qui sainte eglise apele
Sa fille, comme une pucele
Qui de son parante fut nee
Et de ses droiz ors engendree,
Parole a li mont doucemant,
Li mostre son enseignemant
A chascune arme crestiene.
Por ce que n'est pas enciene
Crestientez si com il furent,
Qui la loi Deu avant connurent,
Li prophete, li patriarche,
Adanz et Noe qui [fist] l'arche,
Moyses et la grant lignie,
Cui la loi Deu fut enseignie.
Tuit cil vindrent a la jornee
Ains que la foiz fust atornee.
Se trevaillerent mont devant,
Cant ce vint au soloi levant.[1]
Si furent il ja tuit lasse,
Et de cest siegle trespasse,
Apres eaux qui furent greve,
Cant Dex ot lou soloi leve,
Son fil lou aut roi Jhesu Crist,
Celui qui lou siegle refist,
Qui est adroit soloz veraz,
Qui en nos cuers espent ses raz.
Lor fist li sires sordre et naistre
Sainte eglise qui soloit estre
S'amie douce et s'esposee,
Qui leva avec la rosee,
Quant Damedex qui l'esposa
De son batesme l'arosa.
Por ce doivent tuit bien savoir,
Cil qui tendent a lui avoir,
Que chascune arme batisie
Est a son creator loie :
Por lou baptisme et poi la foi
Est ele esposee lou roi.
Se doit oir que dit David,
Ses ansoignemans et ses diz ;
Ce qu'il mostre et ensoigne a l'une
Doit a son hues oir chascune.

1. Couchant in Vatican copy and Ms. 24,429, Natl. Library, Paris.

36

Cil parole il a la premiere
Sainte eglise cui Dex ot chiere.
'Fille, dit David, 'or escoute
Tu et ta compaignie tote.
Avant te proi de l'escouter
Et dou bien croire sanz doter,
Ce que tuit li prophete distrent
Qui ton sauveor te promistrent.
Tes sires et tes amis seroit
Qui por t'amour s'abaisseroit ;
Et tu seroies soie lige,
De tote joie ploinne et riche.
'Fille, ainceiz que tu fusses nee
Li fus tu promise et donee ;
Et, quant tu auras ce oi
Et dedans ton cuer conioi,
Fille, por ce que tu miheus croies,
.I. pou va avant et si voies
Se Dex ai bien la chose faite,
Ensi com il l'avoit portraite.
Les voies que li rois alai,[1]
Qui por toi avoir s'avala :
N'i a chose faite ne dite
Que bien ne fut avant escrite.
Fille, bien t'ai covans tenir[2]
Por ce que tu vois avenir.
Bien ai toz forfait aquite,
Li rois, li Dex de verite.
Vien avant, fille ; oevre les eaulz ;
Garde se tu pues faire meaulz.
Estil ne dus, ne rois, ne quens,
Si soit ensemble beas ne boens,
Com cil qui d'amer te semont ;
De cui totes les beatez sont.
La lune et li solos sont pale ;
Li ciel sont deslave et de sale,
Se la clarte qui de lui vient
En lor beate ne les maintient.
'Fille, or as hoi t vehu.
Trop auras lou cuer deceu

1. Ala in all other copies.'

2. This couplet wanting in Madrid copy and in that at Ste. Genevieve Library, Paris. Most others read tenu and avenu.

37

Se tu ne mas si entendue,
Que ta beatez li soit rendue,
Se li beas roiz au cuer te toiche.
Lieve sus, fille, si t'aproiche;
Escou tes dras de la podriere;
Si vest ta robe la plus chiere;
Garde c'a ton cors ne se tiegne
Chose qui lou roi desavainne.
Por ce que tu soies plus note'
Si doiz boire de l'obliote.
Se tu vehus estre bele et clere,
S'oblie tot [et] pere et mere.
La ou tu es este norrie
Seroit tost la beatez porrie.
Aime lou roi por fine amor;
S'a[n]belirras de jor en jor.
Et com plus sera li amor fine,
Plus ert la beatez anterine.
' Fille, aime lou roi finemant.
Nulle rien plus ne te demant.
Fim amor t'aprendra a faire
Commant tu li porras meuz plaire.
Fines amors venent de lui;
Et fins amors con de celui
Qui onques d'amer ne se faint;
Ne se demande fors c'on l'aint.
Saige seras se tu me crois;
Et fole, se tu te retrois
Des amors qui rejovenissent,
Et qui ne lassent n'en voillissent.
Lie et johians an doiz bien estre,
Qui es ami lou roi celestre;
Que cil te rejovenira
Desus canquez son ampere ai
Sera tote la soignerie.
N'auras puis garde demorie
Ains seras tot jors bele et gente;
Que la fontaine de jovente
Est chiez lou roi a grant plante,
[Qui te gardera en sante]'
Et concupiscet rex decorem tuum: quoniam ipse est Dominus, Deus tuus, et adorabunt eum.
Li rois David ot sainte eglise
Bien ansoignie et bien aprise

38

Commant ele se doit pener
De li saigement demener;
Que ses cuers sont en amors fins
Et vers lou roi toz enterins.
Mas por ce que plus soit a aise,
Que li respit ne li desplaise,
Et que ne li doie anvier,
Promaître li vet grant loier.
Fille, sez que li rois fera:
Se tu l'aimes, il t'amera;
Si covoitera ta beate
Por qu'il truisse leaute.
Sainz Esperis sera l'amors,
Li solois et li entrecors
Qui de par toi au roi ira
Et tom mesaige li dira.
Tu aparoilles lou sentir;
Saies lou cuer sainz et entir.
Oblie lou panser dou monde,
Que deables ne si responde.
Une chose te di je bien
Que tu garde suz tote rien:
Se t'amors hiere fause ou feinte,
Maintenant seroies atainte.
Sainz Esperite qui tot set,
Qui fointise despit et het,
T'auroit maintenant acusee,
Si seroit t'amor refusee.
C 'onque Dex n'ama ypocrite:
Ja n'aura s'amor ne sa grace
Por fauce priere qui face.
Qui lou mal fait et lou bien faint
Ne dessert mie que Dex l'aint
Garde toi bien de covoitise,
Por quoi li deables atise
Et les avesques et diens,
Si les ammene an ses liens.
Si tu fassoies simonie
Donc par seroies tu honie.
Bien pert s'enor et sa corone
Cil qui vent lou bien que Dex done.
S'avesques est simoniaus,
Si est s'arme pute, cor faus;
N'est mais esposee lou roi;
Qu'en son anel n'ai que lou doi;

39

Et li cuers qui a lui sa ploie
S'est tornez por autre voie.
Tel doivent estre cil por voire
Qu'as bones oevres fassaint croire
Que lor vie est esperitauble
Et lor parole veritauble.
Tu doiz avoir tex tes chaloines,
Priors, clotriers, convers et moines,
Archediacres et abes,
Que lor ordres ne soit gabes.
An apres l'ordre que si aut monte,
Li baron, li roi et li conte
Doivent suegre lou bien qui voient
Et garder ceos qui por os proient.
Se cil qui tel honour receovent,
Sont li prodome com il doivent,
Lors sera tes chiez beaz et gens
A totes les menues gens ;
Et li puples Deu que tu hies
Verront que beal serai tes chies ;
Si se peneront d'agencier
Et d'aus meismes avancier,
Si qu'en ton cors contraval
N'aura taiche ne malvais mal.
Fille, ton cors et t'ennor garde.
Se tes amis li rois te garde,
Belle fille, nes t'esmaier ;
.i. pou te sofre a deslier.
Tant que tu soies andormie
Que li rois ne venrai or mie,
Avant lou convient abergier
Por desdure an son vergier ;
Tant qui aura cuilli son fruit,
Et si ami hi seront tuit.
[Quant tu aras l'amor sentie,
Vers cui nul hon n'a garantie.]
Et tes beas cors ce retrairai
A la mirre que Dex flerai,
Que ta chars sera anterree.
L'amors qui est or en arree
A mont grant joie essemblera,
Quant tes amis t'esvoiilera,
Lou matin au jor dou ivise,
Seras an ton reame assise,
Roine enointe et ancresmee,

40

Bele et clere et si acemee,
Qu'esmer ne dire ne sauras
La grant joie que tu auras.
A cel jor seras apalee
Amont an la chambre, celee,
A tes iuis verras revele
Ce que Dex ai tor jors cele :
La joie que la amont ai
Ou nuls hons fors lui ne monta ;
Ce qu'onques de iuis ne fut veu,
Ne de cuer d'ome aparaceu ;
La douceor que Dex aparoille
Celui qui a lui se consoille.
Hi qui te porras a asier
De l'acoler et de baisier.
Cil te fera joie et solas
Qui an crois te tent les bras ;
Qui si belement se desploie
Por sa douceor qu'i[l] vet qu'on voie
[Fille, ne t'esmaier tu mie.
Dex te mande par Jeremie
Qui n'est mie de tel maniere,
De si cruel et de si fiere,
Comme ches genz du siecle sont.
D'une lor costume qu' il ont,
Quant feme a laisse son segnor,
Ou par pechie ou par amor,
Et d'autre amor est entreprise ;
Tant qu'ele son mari riens ne prise ;
S'ele vient a repentement
Et recounoist son errement,
Vers son mari riens ne li vaut ;
Por coi que son mari n'en caut,[1]
Por son pechie la en haie,
Seule le laist et esbahie,
Ne l'amaroit ne tendroit chiere :
Miex vaurroit qu'ele fust en biere.
Pour ce te mande damediex
Que li siens cors n'est mie tex.
Il est li dois et la fontaine
Qui tous jors est de douchor plaine.

1. Por quoi! car au marit ne chaut.
—Paris, Nat'l Library, Ms. 1747.
Por quoy quer son mari n'en chaut.
—Rome, Vatican copy.

41

Qui a bone fontaine puise
Ne puet estre qui aue ni truise.
Revien, fille, si esgarie :
Ja la douchors Dieu ni ert fallie.
Si est en luj grans la pities,
Qu' il ne fu onques esprisiez,
L'ame qui de Dieu est desjointe,
S'apres pechie a luj s'acointe,
Puis qu'ele est du pechie retraite,
Dont ele estoit vers luj mesfaite,
Fermement tiegne sa creance,
Si ait en Deu bone esperance.
Pour qu'ele voelle revenir
Qu'il est tout prest del retenir.]
Et filiae Tyri in muneribus vultum tuum deprecabuntur: omnes divites plebis.
David vit an sa profecie
Que ma dame Sainte Marie
Seroit an cest siegle honoree
Et de tot lou mont aoree.
En sa chanson la remantoit ;
Dire vet ce qui an santoit.
Vos fait il, dame, aute et clere.
Qui seroiz Deu et file et mere.
Essauceroiz vostre linaige ;
Sauve l'ennor dou pucelaige,
Virginite sauve et antiere.
Ne porroit soffrir la menere
Que de li essit hons charnez,
Se ce n'estoit meismes Dex.
Por ce savons que bien est vors
Que Dex meismes ert li rois
Don vostre ventres ert toz plains,
Et li pucelaiges tot sains.[1]
Tant li plairai li gentis vouz.
Qui fera vostre cors li prouz ;
Que chastete li prometra,
Que Dex meismes li metra.
La chastete ere saelee.
En[et]la letre sus neelee,
Qui dit que Dex hi entre et ist,
Et nature li obeist.
Ni clame usaige ne droiture

1. Wanting in Madrid copy, and in Ms. 1747, Nat'l Library, Paris.

42

Qu'en contre Deu n'a rien nature :
Nature est que nuls hons ne naisse,
Se lou pucelaige ne laisse
Tot avant cele qui lou porte.
A celui naistre oevre la porte.
De vos cera tot autrement ;
Bien lou savons segurement,
Que la vostre sainte [v]antree
Sera toz jorz close l'entree.
Ja au naistre ne au concevire
De chastete ne seroiz seivre.
Mas por ce que solz ert li hons
Qui naistrai sen corrupcion,
Saint Esperites hi serai
Qui toz nos onbeira.[1]
Se vos ferai onbre sanz nue,
La vostre char n'ert corrompue.
Por ce feront en remambrance
Vostre vuel et vostre senblance.
Les riches dames qui seront
A chief enclin la oreront.
Omnis gloriae e jus filiae regis ab intus fimbriis aureis circumamicta varietatibus.
Ce vers dit que mont par fut bele
Cele sainte dame pucele,
Que Dex ot a son hues eslite :
Sa beatez fut de grant merite,
Que le venoit devers lou cuer,
Dedans an ot plus que defors.
Si fut ele por tot si granz,
Com plus puet estre fors et danz,
Can deviser n'ot que redire.
Mas li rois qui ou cuer se mire
Prise lou cuer sus tote rien,
Por ce que plains est de tot biens :
Ou cuer sont les freingetez d'or,
Li treceor et li honor,
Li joial et li tissu de soie,
Que la pucele li anvoie.
Li bons pensers que li rois eime
Dou gentil cuer se lou reclaime.
Qui font les bones sevres foire

1. Spelled in various ways in other copies: AOMBERRA, AUMBRARA, even OBUMBERRA. But AMENISTERRA in Ste. Genevieve Ms.

43

[Por avoir s'amor et atraire]
Sont li joial qui plus covoite.
Nostre dame an fut si adroite
Que toz ses cuers a Deu aloit.
David panse ne li chaloit.[1]
[Cele a lui pas ne falli
Que por ce revint Dex a li.]
Adducentur regi virgines post eam: proximae eius afferentur tibi.
Qui bien orroit et entendroit
Que David conte ci endroit,
Toz li cuers li devroit esmeure
En bien panser e au bone oevre.
Si esgarda David mont loint
Cant Dex, qui tot ai an son poign,
Li mostra la gloire a ses sains,
Don il devoit estre compains.
Bien l'aperceut et bien lou vit
Et bien li fut mostre et dit,
C' apres .I. jor dou grant ivise,
Cant damedex par sa justise
De sa paille et de son estrain
Aura seure tot lou bon grain,
Li grains ert sauz ou que il aille;
Li vens amportera la paille.
Si ert departie et espandue
Ni aura puis nule atandue.
Bien sait qui de raison est plains
Que la bone arme est li bons grains,
Qui la bonte estraint et serre
Et fait venir an ferme terre.
La paille qui au vant s'envole
Cui li vens dechace et demeine,
Cant il la trove voide et vaine.
Li malvais vens est li orguez,
Qui l'arme fiert anmi les eauz.
Li orguez qui l'arme sostient,[2]
C'est li pechiez qui plus li grieve.

1. This and the two following lines as follow in Ms. 1747, Natl. Library, Paris:

D'autre chose ne li chalioit
Cele a lui pas ne falli
Que por ce revoit Dex a li.

2. Other copies have SOLLIEVE, variously spelled

44

Pecherres qui par orguel peche
Ne pet avoir plus male teche.
Mostrer e ansoignier vos veul
Qui bien se garderoit d'orguel
Ne porroit pas estre si maus,
S'il avoit foi qu'il ne fut saus.
D'orguel venent malvais vice,
Larrecim, murtre e avarice,
Et maint pechie que nuls ne cuide,
Et traisons et homecide;
S'autre peçhie d'orguel ne vient,
S'est li orguez qui lou sostient.
Se pecherrez se sent mesfait
S'il maintenant ne s'en retrait,
E anvers Deu ne se humilie,[1]
C'est orguel qui lou cuer li lie.
Por ce vos di tote la some
Riens sens orguel ne destrait home.
Si com David nos ai conte,
Cant damedex par sa bonte
Aura tot orguel abaissie,
Li orguillor, tuit eslaissie,
S'en torneront aval fuant,
Et li deables apres bruant:
Tuit livre en peine ventoire.
Lors ovrera li rois sa gloire:
Si verrons la procession,
Que David vit en vision;
Mont ert la feste aute et bele
Ni aura dame ne pucele
Que ne voist apres nostre dame,
Saine et sauve an cors e an arme.
Si vers apres conte la joie.
S'est bien droiz que madame l'oie;
Cui damadex maintainne et gart,
Si qu'ele entiere en ait part.
Afferentur in laetitia et exultatione: adducentur in templum regis.
Por .I. sanblant que David conte,
Selonc ce qu'en cuer d'ome monte,
Poons antandre e aparsoivre

1. RELIE in Ms. 2094, Natl. Library, Paris; in other copies this and the preceding pronoun joined, S'UMILIE, or S'IMULIE.

45

La grant joie don Dex aboivre
E anlumine toz les suens ;
Qui mont par est beals et boens.
Une senblence nos hi met
Por quoi gran joie vos promet ;
Ansinc com an cest siegle avient
A la gran joie que li rois tient,
Quant il doit corone porter,
Por sa autoce conforter :
Des barons hi a tant ansanble
Que desos aus la terre tranble ;
Les honors font ; les grans dons donent ;
La feste est grans ; les cloiches sonent ;
De totes pars li siegles cort ;
Chascun s'adroce vers la cort.
Li prince ammenent la roine
An joie que Dex la destine ;
Toz li siegles fremit et bruit ;
Vers la roine esgardent tuit ;
Chascun se pene qui la voie.
Li chace vont mont belement ;
Se la portent seurement.
Ele s'oblie antre lor bras
De la grant joie et dou solas ;
Une doucor au cuer li vient
Si que de li ne li sovient.
Cest joie que la roine ai
Ensi com Dex li destinai,
Ce dit David a mont grinor,
Auront devant nostre signor
Cil et celes qui sauf seront ;
Et tot ensi les porteront
Li ange Deu antre lor mains.
Et si ert cest joie certains
Comme cil qui faut ne lasse
Envers celui qui tost trespasse.
[Ne dites pas que ja[je] contreuf
Ke cascune ame aura tot neuf
Des ammerres por lui embrachier
Et deporter et solachier.][1]

[1]. Supplied from Madrid Ms., and found in others also, which read AMES, ANGES, or ANGELS, ANGLES, ANGRES instead of AMERRES.

46

Nos savons par les escritures,
Don les paroles sont seures,
Que .x. ordres d'anges estoient,
Qui ciel et terre et mer gardoient
Que Dex fit au commancemant.
Li une prit put amandemant
Qu'en contre lui s'en orgueilli ;
Et li fiz Deu les acuilli
Par sa puissance la autisme ;
Les trabucha jusqu'en l'abisme.
Bien dut lor grans orguel abatre,
Ca vers lui se voudrent combatre.
Si en furent a ceu mene
Qui sont or deable en penne,
[En leu de cels qui lors chairent
Et qui dameldiex envairent]
Sera li hons qui se humilie,
Qui bien croit Deu et merci crie ;
Qu'en lui d'orguel est simpletez
Et douçor et humilitez.
A ce aut jor dou samedi
Sera por vor, si com je di ;
Et de chascune ordre de ceauz
Istra un anges clers et beauz.
.IX. et .IX. vanront tuit vers terre ;
Chascun .IX. por lor armes querre.
De char et d'os la vestiront,
Droit devant Deu la conduront ;
A douce vois iront criant ;
Cele en ira entr' aus riant.
A tel joie e a tel delit
Iront li sain et li eslit.
Lors ert la joie ou ciel pleniere
Que la maisine iert entiere.
Mas la raison vos dira gie
Por quoi li ange seront lie :
Il ont bien l'oevre Deu vehue
Et sa pidie aparcheue ;
Que Dex ai forme d'ome prise
Par sa doçor et sa frainchise
Nos ai acuilli en frairage
Si s'est mis an nostre linaige ;
Por la autoce lor signor
Porteront la lignie honor.
Et cant home entr'aus ira
En la forme que lor sire ai

47

A lui servir et honorer,
Ne voudront mie demorer.
Flors de roses iront cuillant,
Et flors de lis soef flairant;
Et violetes qui sont perses.
S'en feront corones diverses.
Chascun l'aura selonc sa vie,
Tel com il l'aura deservie.
De ce est il segure chose:
Que li martis aura la rose,
Qui est vermoille comme sans;
Lou lis qui est si beas et blanz
Celui aura, por verite,
Cil qui ai foi et cherite.
Cil qui tevent[1] cherite florissent
Si que les flors de lis en issent.
Chastetez, qui est sainte et note,
Aura la flor de violote;
Qui croit an bois et an montenes,
Si que marois venir ne deigne:
Si senefie en sa nature
Ceos qui se gardent de luxure.
Selonc sa vie et sa menere
Aura chascuns corone antere,
Tel que la flor ni blemira.
Et Dex meismes li dira
Qu'il li done par fim covant
A toz jor mais freiche, rovant.
Saura antre les flors devise.
Li une ert[2] an sus l'autre assise,
Por la corone qu'on la voie
Qui par antre les flors champoie.
Les corones sont anterines
De pierres precioses, fines.
N'i a celi qui bien ne pere.
L'une est d'esmaraude clere
Et l'autre d'un saphir espris,
De grant beate et chier pris.
Li martir que Dex ai ame,

1. This word cannot be identified
In Vatican Ms., Rome, this line reads 'Qu' oevres de charite florisse.'
Similarly in other copies.

2. Madrid and Ste. Genevieve copies read EST; Ms. 2094, Nat'l Library, Paris, has SERA.

48

L'a d'un rubi si enflame[1]
C'a celui qui de loint l'esgarde
Semble que toz li chief li arde.
Cil cui Dex ai tel don done
Seront adroit roi corone:
Nuls rois n'a corone an cest monde
Si entiere, ne si roonde.
Tot jors hont roi guerre ou tenson,
Poor de mort ou cusanson;[2]
Et la androit ou li rois dote
Est la corone fauce et rote.
Mas qui cele corone aura
Ja tant regarder ne sera
Que de totes pars ne l'an sovene
La joie qui toz jors engreine.
Pro patribus tuis nati sunt tibi filii; *constitues eos principes super omnem terram.*
Bien devez matre la table
Por lou maingier esperitauble.
En cest joie que David voit,
Qui tot lou cuer li avivoit.
.III. vers vet violer et dire,
Que Dex meismes li espire.
Por leans va; si s'esbeloie;[3]
Ne li dessiet chose qui voie;[4]
L'arson retoiche a la viole;
Si commance une note bele.
Chanter vet des fiz la roine.
Por sa chanson fai entreine
Mont belement la reconforte.
Vos cuidastes, dame, estre morte,
Cant vostre anfant furent ocis;
Or sont signor de paradis.
Cist anfant, dame, sont tuit vostre,
Cist aut martir, cil saint apostre.
Mont por eutes grant delour;

1. Aura le rubin si enflambe.
—Rome, Vatican Ms.

2. Ste. Genevieve copy reads D'ACHOISON.

3. Par leanz vet [va] si s'esbanoie.
—Paris, Nat'l Library, Ms. 24,429, and most other copies likewise.

4. Ne li desplaist chose qu'il voie
—Madrid Ms.; Ste. Genevieve copy has DESPLET.

49

Nerci lou cuer et la colour,
Cant vos lor veistes mal faire,
Lors cors traitier et detraire.
Toz li siegles vos corroit sore.
Dex vos soffroit cele fort oevre,
Qui li maire quant ele anfante,
Qui est angoisseuse et dolante
Jusques tant que Dex la delivre ;
Cant ele set son anfant vivre,
Lors ai sa delor obliee,
Que Dex la tote recriee.
Dame, li vostre anfant naissoient
Cant par martire vos laissoient.
Et [A] cel grant joie, a cel bel estre,
La façoit Dex issir et nestre.
Grans fut li dues[1] au departir,
Cant vostre precios martir
Lou seigle avoient en despit,
Lor joie mistrent en respit
Et soffrirent en atandue
Jusques Dex lor heust randue.
Onques por prince ne por roi
Ne guerpirent Deu ne sa loi.
Or est la chose si changie
Que nos ai li rois vaingie.
Ou sont or li felon tirant,
Qui nos aloient detirant ?
Lor vertu est bien assomee ;
Que tot issi come plomee
Sont en l'abisme descendu ;
Et vostre anfant vos sont randu.
Mont fut preciose la mors
Don si est bias li reconfors ;
C'or sont prince et signor de terre.
Ja en lor marche n'aura guerre.
Roine estes de riche cort.
Veez la joie qui vos sort.
Crehus ai Dex vostre lignie
Tant que vigne est avignie.
Cest chanson que je vos chant
Por quoi je vos garni avant,

1. DEULS, DIAX, DIAUX, DOUS, DEX in other copies, DONS in Madrid Ms.

50

Ensi com Dex lou me consoille,
Vos dira se pres de l'oroille,
Cant ceste joie ert avenue,
Que je ai en vision vehue.
Memores erunt nominis tui in omni generatione et generationem.
Ce vers conte le remembrance
Et la bele requenoissance,
Que cil de paradis auront.
Vos est provez que tuit seront,[1]
An sans l'auront e an memoire
Que Dex, li doux pere de g[l]oire,
Les aura delivrerai de l'essil
Por son tres chier precior fil.
C'est la fontene de pidie,
Por quoi sont de prison getie.
Lai iront[2] tuit communement
Et amerons[3] si finemant ;
Chascuns de tote sa vertu.
C'onques si grans amors ne fut
Celui qui la besoine fit
Nostre Sauveor Jhesu Crit
Son fil, sa destre, sa poissance,
Sa douce voiz, sa sapiance
Por qu'il sot si soeure portraire
Qu'il ni eust rien que refaire
Celui devront il bien amer
S'entendront tuit a lui loer
Ja ne reposera cil los
Que li loiers hi ert li repos
Li beas rus de la fontene,
Qui lou siegle conduit et mene
C'est la vertu Saint Esperite
Por quoi Dex antre nos abite.
Lors apenra tot et dira,
Et tot lor cuer raemplira.

1. This and next line as follows in Ms. 1747, Nat'l Library, Paris :
Vors est provez que tuit sauront,
En cuer l'auront e en memoire,

2. This line in other copies begins with LOERONT, LOERENT, LOIRONT, LOERUNT or LOERUM.

3. All other copies have a form of the third person here: AMERONT, AMERUNT, AMERENT.

51

Si qu'il sauront canques ou monde,
An ciel, an terre, an mer parfonde.
La chars est soltilz et legiere :
Ne la tienra murs ne maisiere[1]
Plus iront de lui en lui
Que stancele ne saut de feu.
La ou ira la velontez
Hiert maintenant li cors ale.
Ne ja li hons n'aura mestier
Ne de boire ne de mengier ;
Que cors n'aura rien que desmise,
Que dechie ne que blemise.[2]
Damedex qui est li veras pains
Qui or saombre entre les mains
A ceos qui font son sacremant ;
Qui s'abaisse veraemant
An la mie que nos veons.
Icil sires que nos veons.
Emplira sa senefiance
Qu'il sera nostre sostenance.
Li sacremans est fais de pain
Qui paist l'ome contre la fain ;
Et nostre sires qui i vient
Est li pains qui l'arme sostient.
Si nos ravive por son cors
Quant li deables nos ai mors.
Et por ce que li cors ravive
L'arme qui est morte et chetive,
Cil sacremens nos senefie
Qu'il meismes ert nostre vie.
Or vient il por nos conduire ;
Que enemis ne nos puisse nuire.[3]
Lor lou verrons nos face a face ;
Si nos paistra sa douce grace,
Qu'entre nos ert et remaindra,
Lou cors et l'arme sostenra.
Et puisque la vie ert si fors
Comment i revanroit la mors.
Qui vaincuz est il fuit a des,
Que cil qui vient nou tiene pres ;

1. Rochiere in Ste. Genevieve copy.

2. Qui decline, qui enviellisse.
—Paris, Arsenal Library, 3518.

3. Que nus nes ne nos puisse dire.
—Ms. 2094, Nat'l Library, Paris.

52

La mors fut vaincue et conquise[1]
Cant la vie fut ou cors mise ;
Et par .I. mot que Dex i dist
Savons nos bien qui s'en conquist.
Mors, or fai canques tu porras
Que tu meismes te morras ;
Lor fut por voir faite [la] lute
Por quoi Dex ai la mors destrute.
Et a cel jor la destrura
Si qu'en l'abisme s'en fura ;
Chacie an ert et fors seuree
Et nostre vie asseuree.
Propterea populi confitebuntur tibi in aeternum : et in saeculum saeculi.
Por cest leu et por cest desduit,
Ce dit David, loeront tuit
Communemant nostre signour,
Chascuns de tote sa vigour.
Nule riens n'ert an tot lou monde
Que au loer Deu ne sa ponde :
Les puissances et les natures
Et les diverses creatures,
Ange, archange et les vertuz,
Et li hons qui est revestiz,
Li ciels, la terre et la mer
Et li airs, qui si por est cler,
Que ni aura ne vent ne nue,
Ne rien qui grief a la venue.
Solois et lune chanteront ;
Les estoilles s'acorderont ;
Ce sont li ange qui les meinent
Et qui de Deu servir se poinent.
[Ne sera nus que Dex ne lot
Ne qui ne die som bon mot.][2]
Chascuns a douce melodie.
Ni aura qui trop ne poi die.
De cel grant joie et de ce lox
Nos dit li apostre Sain Pox ;
Que nuls cuers sauroit esmer
Tant si seust bien acemer,

1. The two following couplets wanting in three copies : Paris, National Library, Ms. 24,429 ; Ste. Genevieve Library, L. f. 13, and Madrid copy.

2 Wanting only in this copy.

53

[Ne oil voir n'oreille oir] [1]
Joie tant face conioir.
Ci endroit faut Eructavit,[2]
Li bons salmes au roi David,
Ou damedex nos mostre au doi
Lou fondement de nostre loi.
Chanson de chambre l'apela
Ainsi com Dex li revela.
Saichiez que c'est fontaine et puis:
Plus hi a que dire ne puis.
Le gentil suer lou roi de France,
Recorde ci vostre creance.
Pansez, dame, de bien amer,
De servir Deu et reclamer
Celui qui la foi nos espire
Ou vostre gentiz cuers se mire.

1. Wanting only in this copy.

2. Here and at the beginning spelled by the copyist ERUPTAVIT.

54

Mont l'avez fin e agusie,
Ne sai ou vos avez pusie,
Mas d'une rien(?) fais je saige [1]
Que mont avez grant avantaige
C'un mot ai en sainte escriture
Qui grant bien vos asseure;
Qui Deu aime, de lui enquiert
Seure soit il que meulz l'en ert;
Mont met son cuer an bon escole
Qui velontex ot sa parole.
Et vos estes toz jors li prestes
Au roi a destre e a senestre,
Li bons maistre don vos avez
Retenu ce que vos savez.
Si com il est veras amis,
Croissent li bien qu'il hi a mis.

[EXPLICIT ERUCTAVIT.]

1. Mes d'une chose vos fais sage. The above is the usual reading.

With one exception, all copies consulted are immediately followed by some sixty lines, of the same meter and style, which were evidently regarded by copyists as a continuation of the *Eructavit* itself. This seems, however, to be a separate composition, or probably two,—being a narrative of Isaiah's martyrdom and of the miraculous quenching of his thirst, twenty lines, followed by a prayer of forty lines, divided into three portions, to which the divine names of the *Gloria* serve as titles. That these forty lines form an independent composition would appear also from the fact that they are found appended to another Biblical paraphrase of a different meter; in this case, too, a metrical version of the *Song of Solomon*.[1]

The Madrid copy is alone in adding at the end:

'Amen: que cel sire l'otroit
Qui ceu bien set et ot et voit.'

These two lines are much like a couplet ending an old metrical version of tne Lord's Prayer and the creed, which version is considered the earliest existing in that form.[2]

[1] See Bonnard's *Traductions de la Bible en vers francais au Moyen Age*, p. 161. This work, published in 1884, shows that this form of religious poetry was very abundant, and that much of it is still worthy of study.

[2] See *Bulletin de la Société des anciens textes francais*, 1880, 1.

To show the variations of text that arose from local varieties of speech, and perhaps from liberties taken by the scribe with the original, the same passage from two different copies is here compared. The passage chosen for this purpose is the first part of the poem proper, in which a dialogue is in progress between David and the angel at the gate of paradise. The versions thus represented are most widely separated geographically, the first being made, it is said, in England, and the second in Southern France, probably about the same time.

ENGLAND.	SOUTHERN FRANCE.
'D'une dolçor ai plain le quer;	D'una douçor ai plen le cuer
Ne pois muer en nul fuer:	Ne puis muer n'en isse fuer
Ma chançon voil dire le rei,	Ma chanson vueil dire lo roi
Le halt seignor en qui io crei.	Lo aut segnior en cui ie croi
Encore en sa chambre est repos,	Encore est en sa chambre enclous
A son deduit et a son repos.	A son desduit, a son repous.
'Seinz Espiriz, oevre mei l'us.	Sains Esperiz, ovrez moj huis
Je chanterai, si entrer pus;	Je chanterai s'entreir i puis.
Si dirrai un sonet novel.	Si li dirai un son novel.
Si li reis l'out, molt li ert bel.'	Si li rois l'ot, molt lien er bel.
De cele part u l'entre iere	De cele part ou l'entree ert
Revent une voiz halte et clere,	Revint une voiz aute e clere
Que lui dist, 'David, trei te en suz;	Que li dist, 'David, trai t'en sus,
Gardez; ni aprochiez plus.	Guarde que ni aprochier plus;
Lui reis se deduit et repose.	Le rois se desduit e repose.
Ne serreit pas asseure chose	Ne seroit pas seure chose
A ton oes oir ne saver	A ton hues oir ne veoir
Ceo qu'om mortel ne pot veer;	Ce que nus hom ne puet savoir
Ne poet vere home mortels	Ne puet savoir nuls hom charnex
Quels est ioie espiritels.	Que est la ioie esperitex.
Mes la chançon que tu vols dire,	Mes le chançon que tu vuels dire,
Escrif la en bref u en sire,	Escrit en chartre o en cire
Et io frai tant por tei;	E ie ferai bien tant por toi
Et io la mustrai al rei;	Que ie la porterai lo roi.
Si tu la me bailles escrite,	Si tu la me bailes escrite
Ben li serra mostre et dite.	Bien li sera mostree e dite
Jo li dirrai ceo que tu diz.'	Je li dirai ce que tu diz.
'Merci, sire,' ceo est Davis,	Merce sire, ce dist Daviz,
'Si io laienz entrez estoie,	Si ie leens entrez estoie
Od les moz iugleroie;	Avec mes moz vieleroie:
Jogleres sui, sages et duiz;	Joglerres soi, sages e duiz;
Et li reis pleseit mes deduiz;	Si le roi plaisoit mis desduiz,
Jo sai molt ben que les sodles	Ce sai ie bien, que las sodees
Me sereient molt granz dones.	Me seroient molt grans donees.
'Bels sire,' ceo dit Daviz,	
'Ne ma nentez issi mes diz.	

Ne dites pas que io les escrive.	' Ne dites pas que ie l'escrive.
La lange et li quers advue (?)	La lengua cui le cuers avive
L'escrivera sanz dei et sanz mein	L'escrivra sens doiz e sens mains
Assez miels que nuls escriveins.'	Assez meils que nus escrivains.'

The manuscripts of the *Eructavit* copied and cited above are as follows: British Museum, add. 15,606; Rome, Vatican Library, 1682; Madrid, National Library, E.e. 150; Paris, National Library, 1747, 2094, 24,429, and the fragment found in 902; Arsenal Library, 3518; Ste. Genevieve Library, L.f. 13.

Copies examined besides are all at Paris: in the National Library, 1536, 20,046, 25,532; in the Arsenal Library, 3516.

The copy said to be at Vienna, Bibl. Palat., 3430, has not been examined by the editor.

LANTERN SLIDES WITHOUT A NEGATIVE.

W. G. Tight.

As improved methods of teaching are being constantly developed and the instructor is anxious to avail himself of them, there seems to be a growing demand for the stereoptican. In fact the time has already arrived when the class-room is not complete unless there is present some good instrument for projection. And there is no department of instruction in which it cannot be used to advantage. Its value lies in the fact that a large number of individuals may view the representation of the same object during its explanation. There are a number of large firms who make it a business to prepare slides for class-room and lecture work. But the instructor who depends wholly upon these to supply the needed slides has yet to learn to what manifold uses his instrument can be put. One can not buy what is desired. One must learn to make for himself. As the requirements of every teacher are different and each one laboring alone as it were often hits upon little methods that might be useful to others working in different lines, it is my intention to give a few of my various methods for the manufacture of my own slides, trusting there may be a few points of value to some one. It is my purpose to speak only of those methods in which no negative is required for the preparation of the slide, and first of those methods in which not even a camera or but little knowledge of photographic manipulation is required.

Next to the use of a blackboard and free hand drawing for representation comes the preparation of a slide for the lantern by drawing on glass. The glass must first be prepared and under this head might be mentioned two ways:

First, flow the glass with a solution of collodian, or a negative varnish and when dry, write or draw with a fine pen and india ink. This gives the desired object in black against a white ground.

The second way gives a light drawing against a dark ground and this may be accomplished by smoking the glass over burning camphor and drawing the design with a needle point. To make this permanent, flow with collodian or a negative varnish. Always preserve all

fogged negatives and light struck plates and with a glass cutter cut them into lantern size and then utilize the opaque film by scratching in designs with a sharp point. These are especially useful for presentation of formulæ and tables and outline work.

A second class of slides may be made by transfere, a sort of decalcimania process, which as a rule has not been found satisfactory, though sometimes employed. The picture desired may occur in a newspaper, it can be cut out and cemented face down on the glass with some cement insoluble in water, (collodian or negative varnish,) then the paper can be moistened and by careful rubbing with the fingers can all be removed and leave the ink of the picture on the glass. This should also be varnished to protect it.

The third class of slides may be made by the use of thin objects and sections mounted between glasses, opaque objects whose outline is desired. Skeleton leaves to show venation Histological preparations which are large enough. Of course it is not intended to include under this head preparations for microscopic projection, as that would make a subject for separate consideration.

We would now speak of the slides which are made by photographic methods.

And here the simplest slide is the negative. A negative is the first plate or film made with a camera or otherwise, which reverses the lights and shades. Very many slides show to a better advantage in the negative than in the positive. A drawing may be made with a black crayon on a white paper and with a white crayon on a blackboard—both may be positives. Many book illustrations which it is desired to copy into a slide have a black background. Their negative shows a white background and a dark object. The use of a negative from a book illustration which had a white back ground, in many cases, is very satisfactory. A sure rule is: *Whenever the background or the shade of the design does not represent a* RECOGNIZED CHARACTER *of the object presented a negative is equally as appropriate as a positive* When this is the case the shade should always *accord* with the *recognized charaetcr.* For example, one may choose to illustrate the recession of the Falls of St. Anthony, from the plates in the Minnesota Report. The water must be represented as *white*, hence a negative must be made for each illustration and from them a positive, requiring two plates, two developments and two elements of time for the production of each slide. While going through just that tedious task the method which is about to be described was discovered. When it is desired to obtain but one slide from a photograph, picture or illus-

tration, or even a landscape, if no sky is present, it can be accomplished directly from the camera, obtaining a positive on the first plate in the following manner :

Develop with any good developer. Do not develop too far, just enough so that the plate is all up. *In no case develop through the film.* In developing use a black tray in which the plate lies perfectly flat on the bottom. Pour off the developer and *thoroughly* wash the plate.

Now expose the plate to the light. The strength of the light depends upon the blackness of the film developed. A weak light for a few minutes gives better results than a strong light for a few seconds.

Be sure that the plate is in close contact with the bottom of the tray, and that no light gets to the back of the plate. Return to the dark room and flow a fresh developer over the plate again and develop until the entire plate is perfectly opaque and the picture appears as a positive on the back of the plate. Wash, and fix as usual. After fixing without washing, place the plate into a reducing solution, and reduce until the high lights are clear, and the picture stands out a nice clear positive. If the plate is stained yellow, it is probably caused by the developer.

Wash very throughly in running water, dry, varnish and mount, and there will have been produced a lantern slide positive, direct from the camera, with the use of but one plate, one developing solution, and in less than half the time required the old way. This can also be applied to contact printing and transparency work.

ERRATA.

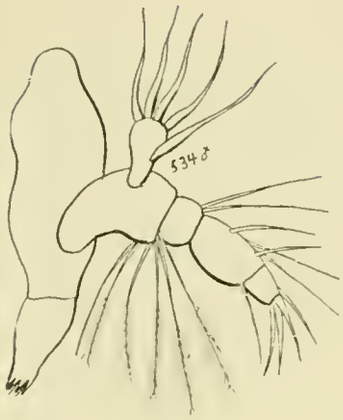
Page 8, Line 13. The sentence should read, "The two long setae are about as long as the combined lengths of the last three joints."

Page 14, Line 25. The word, "taponomic" should read "taxonomic."

Page 17, Line 8. The figures "4 or 4" should read "4 or 5."

Plate I, Figure 6. The elongated spines at the distal extremity of the leg should be three times as long as depicted.

From the middle of the convex border of Figure 7, a short seta has been omitted.

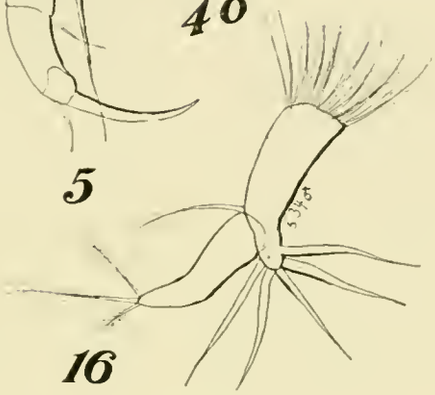


14

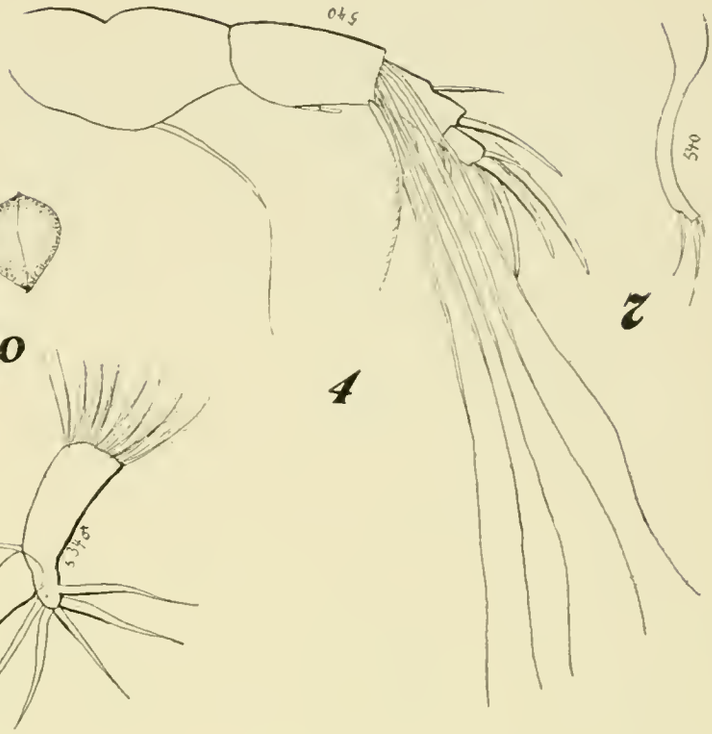
6

5

40



16

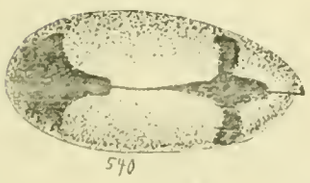


4

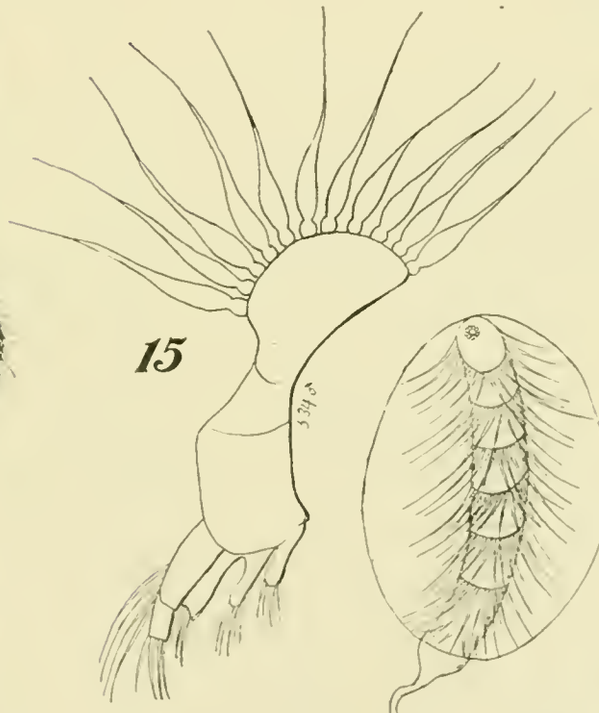
7

3

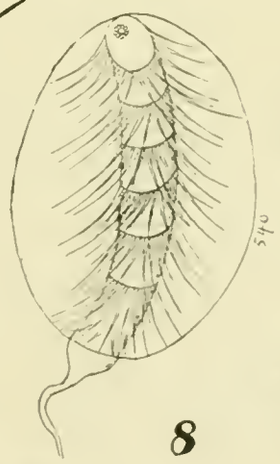
1



2



15



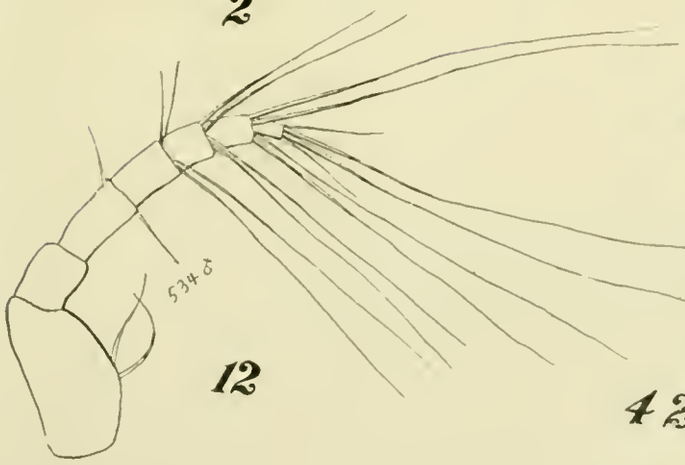
8

10

9

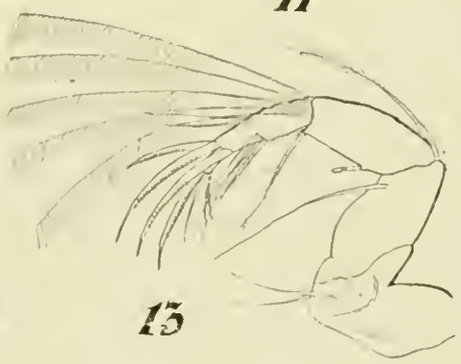
11

41

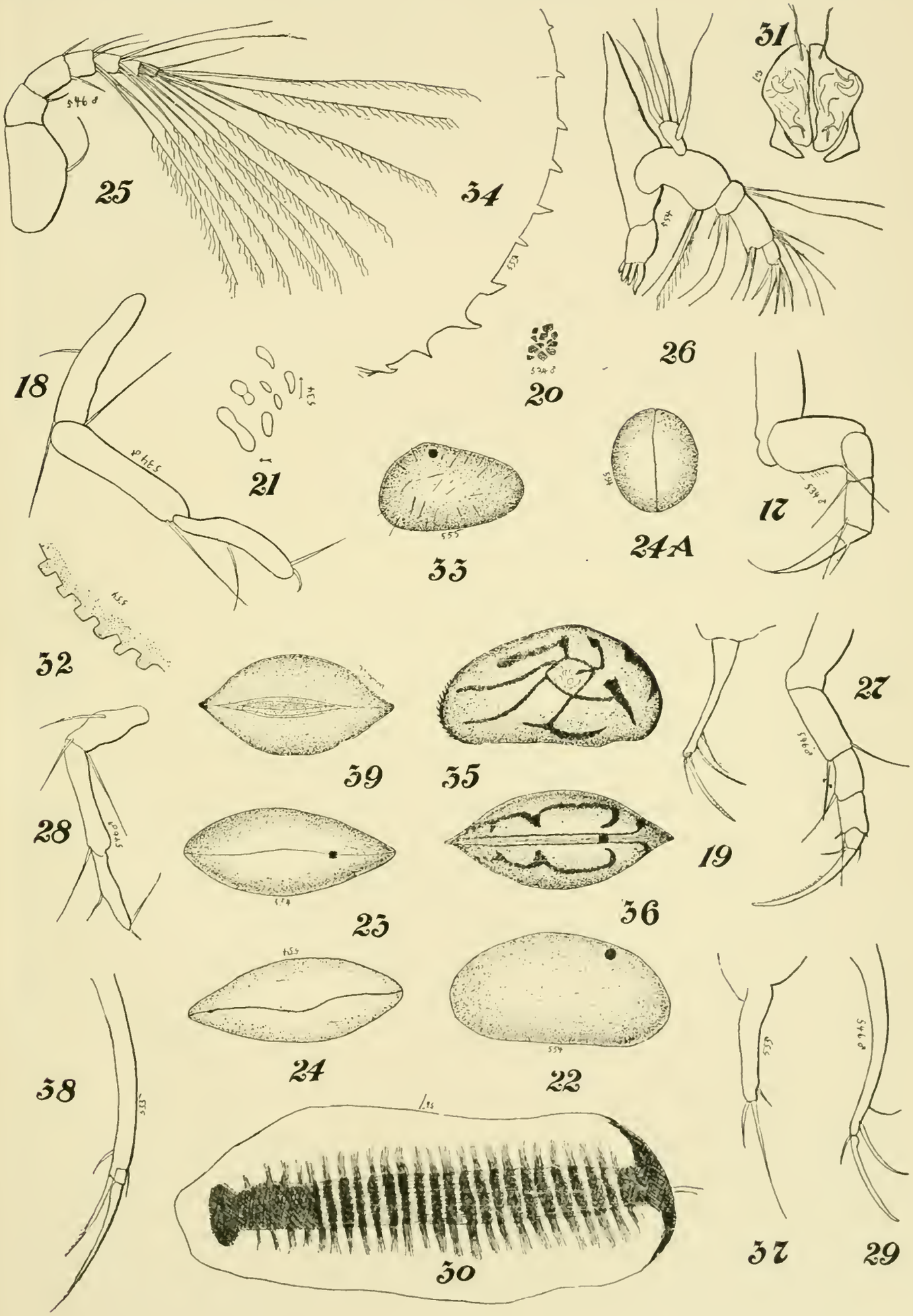


12

42



13


25
34
31
26
18
20
21
24A
17
33
32
39
35
27
28
19
23
36
24
22
38
30
37
29

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOL. VIII, PART II.

WITH EIGHT PLATES AND NINE CUTS.

EDITED BY

W. G. TIGHT, M.S.,

Department of Geology and Natural History.

GRANVILLE, OHIO, JUNE, 1894.

PRESS OF GRANVILLE TIMES.

APR 23 1895

I.

ADDITIONS AND CORRECTIONS TO THE FLORA OF LICKING COUNTY, OHIO.

H. L. Jones.

It has been thought desirable to record the additions which have been made to the Catalogue of Phanerogams and Ferns, published in 1892. A few mistakes which are to be found in that issue are here corrected. Likewise new stations for rare plants are given wherever new ones have been discovered.

The numbers refer to those given in the above mentioned catalogue.

81. Viola sagittata Ait.

Welsh Hills, May, 1892; Ray Evans.

89. Dianthus *Armesia* L.

This has been increasing constantly, in number of individuals since it was first discovered.

92. Silene stellata Ait.

Island in "Old Reservoir," July 13, 1892.

101 and 102 are interchanged. Although careful search has been made no specimen of Cerastium viscosum L. have been found. It is probably a mistaken identification, although the author has not had an opportunity to examine Dr. Jacobs' herbarium.

114. Althaea officinalis L. should be A. rosea L. This was a mistake of the author's in copying Prof. Herrick's notes.

140. Ceanothus Americanus L.

Roadsides southeast of Newark, July 6, 1891.

*146½. Acer spicatum Lam.

Cat Run, north of Granville, June 7, 1892. Prof. C. J. Herrick.

*156½. Polygala sanguinea L.

Tight's farm, three miles west of Granville, July 19, 1892.

166. Psoralea Onobrychis Nutt.

Licking Reservoir, July 13, 1892.

*177½. Desmodium pauciflorum DC.

Granville, O., Sept. 5, 1888. Prof. C. J. Herrick.

180. Lespedeza polystachya Michx.

Welsh Hills.

*181½. Lathyrus palustris L. var. myrtifolius, Gray.

Licking Reservoir. W. C. Werner.

249. Lythrum alatum Pursh.

Welsh Hills, June 29, 1893.

270. Thaspium aureum, Nutt.

This is probably a mistaken identification, the variety trifoliatum Coult. and Rose only being found. In the confusion which has arisen concerning this species it has been thought best to place all our forms under the variety, but many of them agree very closely with the description of the type.

*284½. Osmorrhiza longistylis DC.

Granville, Ohio, H. G. Dorsey, May 18, 1892. Licking Reservoir, C. F. Green, May, 1892.

309½. Lonicera Sullivantii, Gray.

On islands in the "Old Reservoir," July 13, 1892.

339. Solidago uliginosa, Nutt.

Cranberry marsh, "Old Reservoir," August 31, 1893.

*395½. Helianthus strumosus L. var. Mollis T. & G.

Granville, Ohio, September 22, 1890.

*430½. Cichorium Intybus L.

This plant was very common during the summer of 1892 in St. Albans and Liberty townships.

*435½. Prenanthes crepidinea Michx.

Etna, Ohio. H. W. Kuhn.

450. Campanula aparinoides Pursh.

Licking Reservoir, August 31, 1893.

*467½. Lysimachia thyrsiflora L.

Cranberry Marsh, "Old Reservoir," July 1, 1892. Prof. A. D. Selby.

*514½. Cuscuta tenuiflora Engelm.

Licking Reservoir, August 10, 1887.

547. Aphyllon uniflorum Gray.

"Dugway," on road between Newark and Granville, May 25, 1892. G. F. Osbun.

638. Comandra umbellata Nutt.

Cat Run, north of Granville, May, 1892. Prof. C. J. Herrick.

*677½. Quercus coccinea Wang. Quercus imbricaria Michx.

Brownsville, Ohio. Prof. W. A. Kellerman. See pages 234 and 241 of Bulletin of Ohio Agricultural Experiment Station. Technical series, Vol. I, No. 3.

*678½, Quercus imbricaria Michx.

Licking Reservoir; rather common at this locality.

698. Juniperus communis L.

Although frequently reported, I do not think it occurs within our range. All the specimens examined turned out to be stunted forms of J. Virginiana L.

*765½. Juncus Canadensis J. Gay. Var. longicaudatus Engelm.

Licking Reservoir. W. C. Werner.

775. Acorus Calamus L.

This species has been very abundant during the last two years in the ponds around Granville.

779. Wolffia Columbiana Karsten.

This species has been found in one or two other ponds near the Licking Reservoir. It also occurs in a small pool near "Old Man George's Pond" a half mile south of Granville.

*789½. Scheuchzeria palustris L.

Licking Reservoir. W. C. Werner.

*812½. Carex lupulina Muhl. Var. pedunculata Dewey.

Licking Reservoir. W. C. Werner.

831. Carex laxiflora Lam. Var. styloflexa Boott.

Mr. Werner reports that this is probably only a small form of the type.

*840½. Carex echinata Murray, Var. cephalantha Bailey.

Cranberry Marsh, "Old Reservoir," June 1892. Prof. A. D. Selby.

*842½. Carex interior Bailey, var. capillacea Bailey.

On a small island east of the Cranberry Marsh, "Old Reservoir." W. C. Werner.

844. Panicum proliferum Lam.

Granville, Ohio. Sep. 5, 1892.

*928½. Aspidium cristatum Swartz.

Cranberry Marsh, "Old Rerservoir." Prof. A. D. Selby and W. C. Werner.

929, Aspidium Goldianum Hook.

Abundant on Brushy Fork, north of Granville. Prof. C. J. Herrick.

933. Cystopteris bulbifera Bernh.

Spring Valley, near Granville, O. Prof. C. J. Herrick.

940. Osmunda cinnamomea L.

Swamp in Spring Valley, near Granville, O. Prof. C. J. Herrick.

Species marked thus * are additions to the former lists. Subtracting those which are probably mistaken identifications there are 960 species and varieties found in Licking County.

II.

NOTES FROM THE BOTANICAL LABORATORY.

W. G. Tight.

1. Phallus Daemonum.

The genus Phallus of the group of Gasteromycetes is a very interesting one on account of its peculiar life history which it shares with all the Phalloideae. What is usually seen of the plant is only the fruit which arises from a filamentous or compound mycelium resembling roots. This fruit is at first a closed sac of globose form and is called the peridium. It incloses a structure, the gleba, which bears in chambers on its surface the mass of spores. The peridium is composed of two coats, an inner and an outer, with a mass of hyphae which become transformed into a thick gelatinous layer between. Within the peridium and bearing the gleba is the stipe, a central column of parenchyma tissue. The stipe is hollow and is composed of several layers of round celled tissue, and it bears at its apex the pileus which acts as a support to the gleba. At maturity the gleba deliqueses with a very offensive odor. Between the pileus and stipe is borne the indusium or veil.

There are five American species in the genus Phallus. The following description taken from a specimen found at Spring Valley is of one of the rarer species. The accompanying illustration, plate A, is reproduced from a photograph.

Phallus Daemonum Rumph.

Valva globose pinkish, outer wall of indusium 1 mm. thick, volva 5-7 cm. in diameter.

Stipe 3.5 cm. in diameter. Plant 15 cm. high.

Stipe fusiform-cylindrical cellulose. Veil reticulate, hanging straight down from under the pileus to the volva, attached only to the apex of stipe.

Reticulation not extending to the edge of the veil ; margin toothed.

Pileus attached to the apex of stipe, companulate, truncate, gleba not extending to apex. Apex consists of a smooth ring surrounding the perforation which is at first closed with a gelatinous membrane which is the inner wall of the indusium. Pileus 5 mm. long, 5 mm. in diameter at base. Reticulate pitted after deliquesence.

Growing among leaves in woods, Spring Valley, Granville, O., Nov. 5, 1893.

This species is reported by Morgan ; from New York by Peck, Maryland by Miss Banning, Ohio by Lea and Morgan. It is considered quite rare and is little known.

2. Some Floral Monstrosities.

The morphological relations of the organs of the flower have been the subject of much discussion and while those relations are quite clearly expressed for the perianth and stamens and carpels there still remains much doubt about the ovules and pollen sac. While it can not be argued that malformations necessarily assume the archetypical form and that teratological evidence is always conclusive still the fact remains that these abnormal expressions of floral development often illustrate more clearly the morphological relations than the normal development. Striking examples of these modifications are often useful in instruction. The following have been observed and entered upon our register as being worthy of notice. As the sepals are more closely related to the leaves in their position on the stem it is to be expected that the reversions to type will there be found more common. Fig. 1, presents one of these reversions where in the gamosepalous calyx of the Fuchsia one of the limbs has separated from the tube leaving its place vacant and has become

Fig. 1.

transformed into a perfectly developed leaf with a jointed petiole. Otherwise the flower is perfectly normal.

* * * *

That the flower is to be considered a modified stem as indicated by its position in the axil of a leaf and also that the sepals are to be considered as leave, as indicated in the Fuchsia is shown by the peculiar development of a perfectly normal flower in the axil of one limb of the calyx of a flower in Narcissus as shown in fig. 2. All the parts are normally developed in each flower except along the tube of the lower flower there is an expansion extending to the lower torus in line with the upper flower.

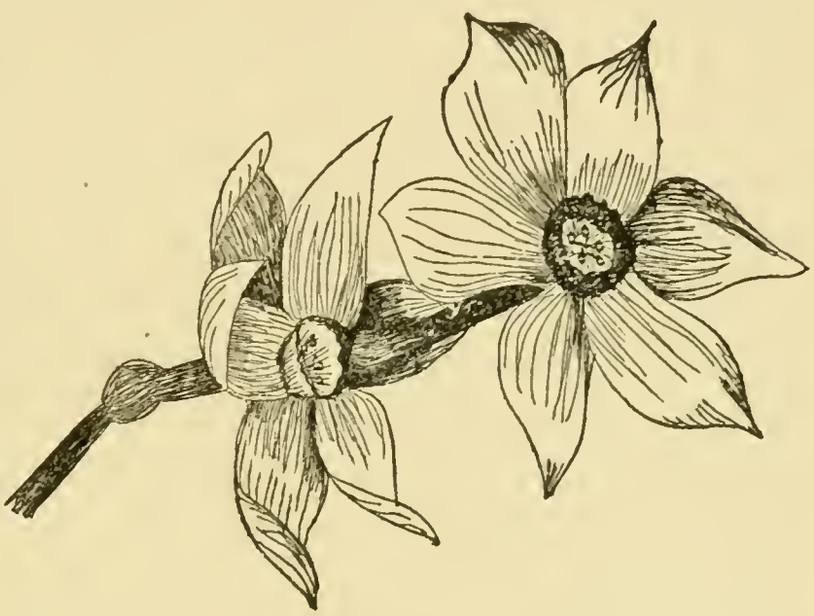


Fig. 2.

* * * *

If we accept the theory that the ovules may be produced either on the carpellary leaves as marginal, superficial and axillary or that they may spring from the extention of the floral axis into the ovary and may then be either lateral or terminal while the carpels remain sterile, it then becomes evident that the morphological relation must be determined for each separate group as the above conditions give the greatest possible range of variation.

In deciding such embryological and morphological relations the malformations become of greatest importance.

It is generally assumed that the female organs occupy the central position in the flower. They always appear in the theoretical and empirical diagram as forming the central circle or circles of organs. When the floral axis is elongated the pistils may occur in concentric circles but more often in close spirals. The latter usually occurs when the pistils are

simple and numerous, when the pistil is compound there is presented a circle of carpels showing more or less perfect coalesence. It is by a possible combination of these two principles that there is produced the peculiar form found in the navel orange, figure 3, where the plurilocular pericarp contains a second circle of loculi bearing a separate style. It is evident that this second included fruit must represent a continued development of the floral axis but whether that continued development should represent a pistil and so a circle of carpels may be questioned. The fact that in this particular variety of oranges the seeds are rare and often entirely wanting, as they were in the specimen studied, would seem to indicate rather that these accessory parts are closely related to the aborted seeds. It would appear then that in the orange and so probably in the citrus family the seeds are to be considered as lateral developments from the central floral axis and the carpels entering into the compound pistil as sterile. The thought suggests its self that the development of the pulp from the innermost layer of the pericarp in the form of isolated lobes of tissue, into the plurilocular fruit, may take the place of the more usual form of seed development from the margin or surface of the carpel leaves.

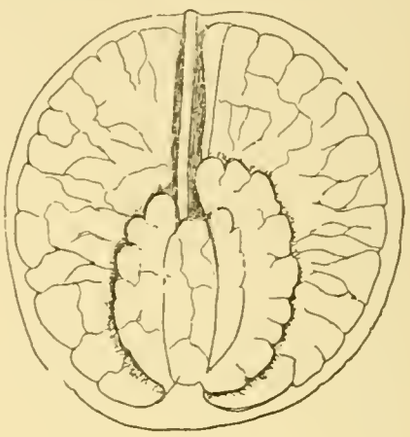


Fig. 3.

* * * *

The morphological relations of the ovules is pretty clearly shown by the following interesting monstrosity in a single tulip:

Figure 4 is a full sized sketch of the pistil, showing two faces of its triangular form.

Figure 5 is the top view of the stigma, which is sessile. The two portions which are contiguous belong to the same carpel as the ventral suture is in the middle of the face and the dorsal at the angle of the ovary.

Figure 6 is the empirical formula for the flower. The perianth is composed of two circles of three members each. Stamens six, in two circles. Pistil composed of three carpels with dorsal sutures at the angles. Placentation central in three cells. Dehiscence loculicidal. There is perfect symetry and perfect alternation of parts on the plan of 3.

Fig. 4.

Fig. 5.

Figure 7 is a view of the cross section of the ovary, twice size. There are six fibro-vascular bundles. The three at the angles represent the midribs of the carpel leaves. The three opposite the faces are the united bundles of the two united half blades. At dehiscence the bundles at the angles are divided, the separation taking place through the middle of each bundle into the loculi. The partitions are formed by the infolded edges of the carpel leaves. Each leaf is completely rolled in and each margin bears a row of carpels. From the stigma and from the strongly developed fibro-vascular bundle in the middle of each face it would appear that the latter was the midrib and the dehiscence down the ventral suture in which case the ovules would probably be considered as lateral axial and so morphologically leaves. That this is not the case is very clearly shown by the examination of the empirical diagram. Fig. 8 made from a flower in which the pistil is ruptured along the lines of its regular dehiscence, but long before its maturity and there is developed a circle of perfect stamens on what must evidently be considered a prolongation of the

Fig. 6.

Fig. 7.

floral axis. The perfect symmetry and alternation of the flower is also maintained in this extra circle. It will be observed that the included stamens are placed alternate to the lines of dehis cence or the midrib.

The three interior stamens were in every way as perfect as those of the normal circles and their time of dehiscence was the same as the others. The appearance of this flower is shown in Figure 9, without the perianth. Only two of the outer whorles of six stamens are shown, but the three arising from the center of the ruptured pistil and opposite each valve will give some idea of the peculiar appearance presented by the flower and expressed in the diagram.

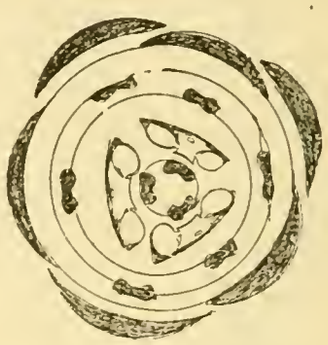


Fig. 8.

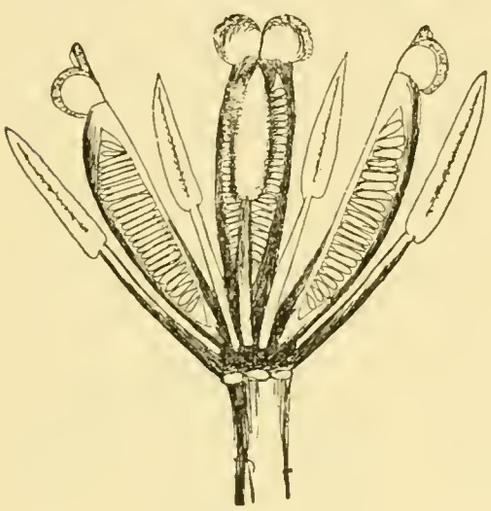


Fig. 9.

Why the prolongation of the torus should have found expression in the production of androecium instead of a second whorl of carpels will probably be explained when the mystery which produced the abnormality itself is solved. This much however seems quite certain that the ovules of the tulip and probably of Liliaceae are carpellary and marginal.

III.

NOTES ON AMERICAN OSTRACODA, WITH DESCRIPTIONS OF NEW SPECIES.

By C. H. Turner.

[*Plates VII and VIII.*]

This paper is a continuation of the articles published by the author in this journal last year and the year before.

I must here thank Mr. A. B. Whitby and Prof. L. D. Hileland, who have kindly collected material which otherwise would have been inaccessible to me. Mr. Whitby collected in Texas while Professor Hileland collected in Delaware and New York.

Genus cypria, Zenker.

Cypria exculpta, Fischer.

[*Plate VII; fig. 2-8.*]

Cypris striolata, . . . Brady: Recent British Ostracoda (1868) p. 372—373; pl. XXIV, fig. 6-10.

Cypris striolata, . . . C. L. Herrick: Alabama Crustacea. (1887), p. 29; pl. IV, fig. 3.

Cypria exculpta, . . . G. S. Brady: Marine and Fresh Water Ostracoda of the N. Atlantic and N. W. Europe, Podocopa. (1889) p. 68–69; pl. XI, fig. 1-4.

Length of female, 0.54—0.64 mm. Height, 0.33—0.43 mm. Width, 0.26 mm.

The shell is thin and somewhat transparent and is covered with a meshwork of sub-longitudinal lines. [fig. 5.]

Viewed from the side, [fig. 3] the shell is orbicular, highest in the middle, the two extremities being of about equal height. The cephalic, dorsal and caudal margins are convex. The ventral margin is slightly sinuate, being concave in the middle.

Viewed from above the shell is an elongated, later-

ally-compressed ellipse. The two extremities are of about the same width and the line of contact is straight.

The natatory setae of the antennae [fig. 6] extend far beyond the terminal claws and are much longer than the entire limb. The claws on the tip of each antenna are long and slender. They are longer than the last three joints.

In the male the second maxillae [fig. 8] are dissimilar.

The tip of the second foot [fig. 2] bears two short ectally projecting setae and two long setae which project backwards as far as the base of the antepenultimate joint.

The post-abdomen [fig. 7] is short, stout and curved. The terminal claw is strong and about half as long as the ramus. About the middle of the caudal margin of each abdominal ramus there is a short filamentous seta.

Habitat: Burlington Ohio, March 1893. Large numbers were found in a small shallow pond. Atlanta Ga., January to May 1894. These were very abundant. Length 0.64 mm. Height 0.43. Kent Co., Delaware, March 31st, 1894. These were collected for me in Jones Creek by Prof. L. D. Hileland. Length 0.54 mm. Height 0.36 mm.

Cypria incquivalva, Turner.

Additional locality: Atlanta, Ga. On the third of Febuary 1894, I found a large number of these in South River Slough. Length 0.48 mm.

GENUS CYCLOCYPRIS, Brady and Norman.

Cyclocypris laevis, (O. F. Müller) Vávra.

[*Plate VII; fig. 9-11*]

Cypris ovum, . . . Brady: Recent British Ostracoda (1868) p. 373; pl. XXIV, fig. 31-34, 43 45, and pl. XXXVI, fig. 8.

Cypris laevis, . . . Brady and Robertson: Marine and Fresh Water Ostracoda of the N. Atlantic and N. W. Europe. (1889) p. 69-70.

Cyclocypris laevis, . . . Monographie der Ostracoden Böhmens. (1891) p. 68-71; fig. 21, 1-6.

Length, 0.51 mm—0.57 mm. Width, about 0.4 mm.

The somewhat translucent shell is hispid and very tumid, being about as broad as it is high.

Viewed from above the shell is ovate with rounded extremities. The eye, which is situated near the cephalic extremity of the animal is easily seen through the shell.

The five large setae on the antepenultimate joint of the antennae extend way beyond the tip of the terminal claws.[fig. 9] The distal extremity of each seta is plumose. According to Prof. Brady[1] in *Cypris ovum* (Jurine) only two of the natatory setae of each antenna are long. In this respect *Cypris ovum* (Jurine) differs from the specimen under consideration; but since they are similar in all other features I consider them to be of the same species.

The terminal joint of the mandibular palp is short. The terminal claws of this palp extend to the tip of the mandibular teeth.

The slightly curved terminal claw of the first foot is slender and is about as long as the combined lengths of the three distal joints.

The terminal joint of the second foot is about two-thirds as long as the fourth joint. [fig. 11] The long, slender, backwardly directed seta upon the distal extremity of this joint is longer than the combined lengths of the three distal joints. This joint bears at its apex two other setae; one, about the same length as the joint is directed backward, the other is very short and is directed forward.

The short post-abdomen is about twice as long as its terminal claws. [Pl. VII fig. 10] The stout claws are feebly curved.

Habitat: I have only seen three specimens of this species. These Prof. L. D. Hileland collected in Jones' Creek, Kent Co., Delaware, March 31st, 1894.

---

[1]Recent British Ostracoda, p. 373.

Genus Cypris, Müller.

Cypris fuscata, Jurine.

Plate VII, *Figs. 41-46.*]

Cypris fuscata.—G. S. Brady. Recent British Ostracoda, [1868), p. 362; pl. XXIII, figs. 10-15.

Cypris fuscata.—G. S. Brady. Marine and Fresh Water Ostracoda of N. Atlantic and N. W. Europe. Podocopa (1889), p. 73; pl. XII, figs. 3, 4.

*Cypris fuscata**.—Wenzel Vávra. Mon. d. Ostracoden Böhmens, (1891), p. 98-99; fig. 33, Nos. 1-3.

Length of the female, 1.5 mm. Height, 0.9 mm. Width, 0.67 mm.

The greatest height of the animal is about two-thirds of the length, while the greatest width is less than the height. The color is greenish brown. The shell usually has attached to it furfaceous matter, which Professor Brady thinks is desquamating epidermis.

Viewed from the side the caudal third of the shell is wider than any other portion. The caudal, dorsal, and cephalic borders are convex. The cephalic and caudal margins have a narrow hyaline edge. The valves are not very transparent and are covered with short, scattered hairs. Muscle impressions near centre of the valve, about seven.

Viewed from above, the shell is oval, rounded behind and bluntly pointed in front. The greatest height is in the middle.

The natatory setæ of the antennae extend to the tips of the terminal claws. The terminal claws are stout, curved and longer than the last two joints. The distal half of the inner margin of each claw is pectinated with a double row of fine teeth.

The two enlarged spines upon the first mandibular process are toothed. The extremity of each spine and the two adjacent teeth are blunt.

---

*Excepting Prof. Brady's monographs, reference is made in this paper to no papers upon European forms, excepting papers that have appeared since the publication of Prof. Brady's last monograph. In each case, however, an attempt is made to refer to all of the American references.

The first foot is five-jointed, the third and fourth joints being distinct. The terminal claw is long and stout, longer than the combined lengths of the last three joints. The second joint is stout and about as long as the combined lengths of the next two joints.

The terminal claw of the second foot [fig. 43] is about twice as long as the terminal joint.

The feebly-curved post-abdomen [fig. 46] is stout and short. The terminal claw is a little more than half as long as the abdominal ramus. The adjacent claw is about three-fourths as long as the terminal claw.

Habitat: Cincinnati, Ohio. Abundant in the canal basins and adjacent pools.

Cypris Burlingtonensis, sp. n.

[*Plate VII, Figs. 14-23.*]

Length of the female, 1.6 mm.; width, 0.89 mm.; height, 0.93 mm; length of the male, 1.3 mm.; width. 0.7 mm.; height, 0.7 mm.

The length of the shell is a little less than twice the width and the height is about equal to the width. The shell is very thin and is covered with long hairs, [fig. 15]. The shell is also marked with certain dark bands, which are due, in part at least, to the internal organs shining through the translucent shell,

Viewed from the side [fig. 17] the shell is sub-oval, but the cephalic extremity is wider than the caudal. The dorsal margin is convex, the greatest convexity being nearer the cephalic than the caudal extremity. The cephalic and caudal margins are convex. The ventral margin is nearly straight.

Viewed from above, the shell is sub-elliptical, the two extremities being more or less pointed [fig. 17] and of about equal width. In some specimens the ends are round. The sides are feebly convex, indeed in some parts they are almost straight and nearly parallel.

Viewed from the end the shell is nearly circular, the sides being very convex.

The antenna consists of five joints, [fig. 20], the fourth joint being very long and slender. The distal joint is narrow, being no wider than the base of the terminal claws. The terminal claws are slender and the distal portion of each is fringed by a longitudinal row of very fine teeth. The natatory setæ extend to a short distance beyond the tip of the terminal claws.

The second joint of the mandibular palp bears, in addition to the usual setæ, a short, plumose, dagger-shaped seta, [fig. 18.] The terminal claws of the palp are slender and smooth.

The two prominent spines upon the first mandibular process of the first maxilla bear teeth, [fig. 16.]

The palp of the second maxilla terminates in three long flexible spines. The middle spine is longer than the whole palp, but the lateral ones are only about two-thirds as long as the middle one.

The first foot [fig. 21] is five jointed, the third and fourth joints being distinct. The second joint is broad and is as long as the united lengths of the next three joints. The terminal claw is longer than the united lengths of the last three joints. The distal third of the cephalic margin of this claw is finely pectinated.

The claw upon the last joint of the second foot [fig. 23] is curved and is about twice as long as the terminal joint.

The post-abdominal rami [fig. 19] are slender and straight. The terminal claws are long and slender, being about half as long as the ramus. They are straight and one margin of the tip of each is finely pectinated. The lower claw is fully three-fourths as long as the distal one and resembles it in structure.

Habitat: These were found in great numbers in a shallow grassy pool at Burlington, Ohio. They were found in the early part of March, 1893, just after the close of a long and severe winter; indeed, there was a light snow-fall the day before the collection was made. Judging by the lay of the land, I think that the pool dries up in summer.

At Atlanta, Ga., just after some heavy rains in January,

1894, large numbers of these active creatures were found in several shallow pools in the South River Bottoms. These pools dry up in warm weather. The specimens remained for about two weeks and then disappeared.

Length, 1.58 mm. Height, 0.94 mm. Width, 0.91 mm. Jones Creek, Kent Co., Delaware, March 3d, 1894, collected by Prof. L. D. Hileland. These were immature specimens about 1.4 mm. long.

Genus Cypridopsis, Brady.

Cypridopsis vidua, Müller.

Additional localities: Atlanta, Ga. This species is very common in Atlanta. It is found in almost all the shallow ponds and creeks. It occurs at all seasons of the year. Length, 0.7 mm.

Colby Co., Texas. A young specimen of this species was found in a collection by Mr. A. B. Whitby.

Genus Candona, Baird.

Candona acuminator, (Fischer.) B. and N.

[*Plate VIII, fig. 34.*]

Candona acuminator, . . . Brady and Norman: Marine and Fresh Water Ostracoda of the N. Atlantic and N. W. Europe. Podocopa. (1889), p. 104-105; pl. IX, fig. 9-10; pl. X, fig. 5 6.

Length, 1.25 mm. Height, 0.58 mm. Width, 0.46 mm.

The shell is smooth, white, and elongated. It is more than twice as long as high and about three times as wide.

Viewed from the side, the shell is sub-reniform, highest in the middle.

Viewed from above, the shell is sub-elliptical with pointed extremities. The widest portion is in the middle. One valve is a trifle longer than the other.

The antennæ are stout. The natatory setæ are absent and the terminal is long and non-pectinated.

The post-abdomen [fig. 34] is curved and slender. The terminal claws are slender and pectinated.

Habitat: Collected by Mr. A. W. Whitby in San Antonio River, Goloid, Texas, March 5th, 1894.

Candona Crogmaniana, sp. n.

[*Plate VIII, Figs. 24-33.*]

Length of female, 1.52 mm. Height 0.76 mm. Width 058 mm.

The shell is very thin, so thin that the ova and spermatozoids are visible through it. It is glossy and is covered with short scattered hairs. These hairs are more numerous around the margins than elsewhere. The shell is greenish yellow in color and numerous vorticellidae are usually attached to it.

Viewed from the side, [fig. 33] the female is sub-triangular, the caudal third being the highest portion. The caudal, dorsal, and cephalic margins are convex. The ventral margin is slightly sinuate, being concave in the middle.

Viewed from above, [fig. 32] the shell is an elongated ellipse, pointed at both ends. One valve is longer than the other and overlaps it at each extremity.

The antenna [fig. 25] is five-pointed in the female. Near the proximal end of the lower margin of the first joint there is one elongated filament and one short, pectinated, dagger-shaped filament. The terminal claws are slender, non-pectinated and long,—longer than the combined lengths of the last three joints. The antenna of the male is six-jointed.

The mandibular palp [fig. 31] is five-jointed. The first joint is large and bears at the distal angle of its inner margin a short dagger-like seta. [fig. 31] The distal half of this seta is pectinate. The mandibular blade is stout.

The spines of the first mandibular process of the first maxillæ are non-pectinated.

The first foot [fig. 29] is long and slender and is composed of five joints. The second joint is about as long as the next two joints. The third and fourth joints are of about the same length. The fifth joint is the smallest of all. It is conical and

from its distally directed apex arises the terminal claw. The terminal claw is slender and long. It is longer than the combined lengths of the last three joints and the distal portion is flexuose.

The fourth joint of the second foot [fig. 30] is very obscurely divided into two joints, so that the second foot appears, under a high power, to be composed of six joints. The foot terminates in two long flexuose filaments and one shorter filament.

The post-abdomen [fig. 28] is of medium size. The terminal claws are slender, pectinated and curved. The terminal claw is about half as long as the abdominal ramus. The adjacent claw is a little shorter than the terminal claw. The filament in the caudal margin is about ⅓ the length of the ramus from the distal extremity of the post-abdomen.

Habitat: Atlanta, Ga., December 1893. Abundant in the shallow ponds near South River.

Candona delawarensis, sp. n.

[*Pl. VIII, fig. 35-40.*]

The color of this form is greenish yellow variegated with blotches of brown.

Viewed from the side [fig. 39] the shell of the female is sub-reniform, the greatest height being about two thirds the length of the animal from the cephalic extremity of the shell. The cephalic, dorsal, and caudal margins are convex. The ventral margin is undulating, concave in the middle.

Viewed from above [fig. 37] the shell is an elongate ellipse with its greatest width in the middle. The extremities are pointed. The hinge-line is sinuous. Near the cephalic extremity there is a very pronounced sinuosity.

Viewed from below [fig. 38] the general outline is the same as when viewed from above. The contact line is more sinuous than the hinge-line.

Viewed from the end, the shell is elliptical. It is widest in the middle and the extremities are rounded.

The antennæ bear no natatory setae on the antepenultimate joint. The terminal claws are non-pectinated and long. They are about as long as the combined lengths of the last three joints. The lower margin of the antepenultimate joint bears a modified sensory seta. The antenna of the male is six-jointed. The mandibular palp of the female is large. The antepenultimate joint bears, in addition to the usual long sensory setæ one short and stout sensory seta which is sub-rectangular in form with truncated ends and convex sides. It is about four times as long as wide.

The spines on the first mandibular process of the first maxilla are not toothed.

The post-abdomen of the male [fig. 36] is slender and subtriangular. The terminal claws are slender and curved.

Habitat: Jones' Creek, Kent Co., Delaware. The specimens that I have were collected by Prof. L. D. Hileland March 3rd, 1894.

NOTES ON THE CLADOCERA OF GEORGIA.

Family DAPHNIDAE.

Genus Ceriodaphnia, Dana.

Ceriodaphnia consors, Birge.

Ceriodaphnia consors, . . . E. A. Birge: Notes on Cladocera; (1878), p. 5; pl. 1, fig. 3-4.

Ceriodaphnia consors, . . . C. L. Herrick: Final Report on Minn. Crust. (1884) p. 40.

Length, 0.55 mm. to 0.61 mm. Height, 0.40 mm. The shell is reticulated, the reticulation being singly contoured.

Habitat: South River Slough, Atlanta Ga., February 3rd, 1894.

Ceriodaphnia megops, Sars.

Ceriodaphnia crtstata, . . . E. A. Birge: Notes on Cladocera, (1878) p. 6; pl. II, fig. 8, 9.

Ceriodaphina megops, . . . C. L. Herrick: Final Report on Minn. Crust. (1884) p. 36-37; pl. A, fig. 14, 19.

Length, 0.85 mm. Height, 0.52 mm.

Habitat: Atlanta, Ga, South River Slough, Nov. 17th., 1893.

Genus Simocephalus.

Simocephalus serrulatus, Koch.

Simocephalus Americanus, . . . E. A. Birge: Notes on Cladocera. (1878) p. 6-8; pl. I, fig. 6.

Simocephalus serrulatus, . . . C. L. Herrick. Final Report on Minn. Crust. p. 46 (1884).

Length, 1.7 mm.-1.9 mm. Height, 1.43, mm.

Habitat: Atlanta, Ga., South River Slough. The specimens examined were covered with Vorticellidæ. These are found at all seasons, Specimens collected on the 17th of November, 1893, were still laying summer (parthenogenetic) eggs,

Family BOSMINIDÆ

Genus Bosmina.

Bosmina atlantaensis, sp. n.

(*Pl. VII, fig. 12-13.*)

Length, 0.46 mm. Height, 0.36 mm.

The shell of this form is smooth. The flagellum is much nearer to the eye than it is to the sensory setæ of the antennæ. For details the figure will answer.

Habitat: Atlanta Ga., South River Slough. During the winter this form was very common. It appeared, in company with *Cypris Burlingtonensis* just after a series of rains, but it remained longer than the latter species. During that time, these creatures were very numerous.

Family LYNCODAPHNIDAE

Genus Macrothrix, Baird.

Macrothrix laticornis (Jurine)

Macrothrix laticornis, . . . C. L. Herrick. Final Report on Minn. Crust. (1884), pp. 68-69; pl. C, fig. 7-9.

Macrothrix laticornis, . . . E. A. Birge. List of Crust. Clad. from Madison, Wis., (1891), p. 390.

Length, 0.37 mm. Height, 0.25 mm.

Habitat: Atlanta, Ga., Mrs. Reeve's pond, Aug. 1st, 1893.

Family LYNCEIDÆ.

Genus Alona,

Alona porrecta, Birge.

Alona porrecta, . . . E. A. Birge. Notes on Cladocera, (1878), pp. 29-30; pl. I, fig. 16.

Alona porrecta, . . . C. L. Herrick. Final Report Minn. Crust. (1884), p. 99.

Alona porrecta, . . . C. H. Turner. Notes on Clad., Cap. and Ost. of Cin'ti. (1892), pp. 67-68. Additional Notes on Clad. and Ost. of Cincinnati,Ohio, (1893), p. 5.

Length, 0.37 mm.-0.58 mm.; height, 0.22 mm.-0.24 mm.

Habitat: Atlanta, Ga., Mrs. Reeves' pond. Found at all seasons of the year; abundant.

Genus Pleuroxus, Baird.

Pleuroxus denticulatus, Birge.

Pleuroxus denticulatus, . . . E. A. Birge. Notes on Clad. (1878) pp. 20-21; pl. I, fig. 21. List of Crust. Clad. f. Madison, Wis., (1891) p. 395; pl. XIII, fig. 21.

Pleuroxus denticulatus, . . . C. L. Herrick. Final Report Minn. Crust. (1884). p. 120; pl. G., figs. 12-13.

Pleuroxus denticulatus, . . . C. H. Turner. Notes on Clad. Cop. Ost. and Rot. of Cin. (1892), p. 68. Add. Notes on Clad. and Ost. of Cincinnati, O., p. 5.

Length, 0.57 mm.; height, 0.43 mm.

Habitat: Atlanta, Ga., South River Slough.

Pleuroxus hamatus, Birge.

Pleuroxus hamatus, . . . E. A. Birge. Notes on Clad. (1878), pp. 22-23; pl. II, figs. 13, 14.

Pleuroxus hamatus, . . . C. L. Herrick. Final Report on Minn. Crust. (1884), p. 110; pl. H, fig. 1.

Pleuroxus hamatus, . . . C. H. Turner. Notes on Clad. Cop. Ost. and Rot. of Cin'ti. (1892), pp. 68-69. Add. Notes on Clad. and Ost. of Cincinnati, Ohio, p. 6, (1893).

Length, 0.46 mm.-0.52 mm.; height, 0.23 mm.-0.33 mm.

Habitat: Atlanta, Ga., Mrs. Reeves' pond.

Genus Chydorus, Leach.

Chydorus sphaericus, Müller.

Chydorus sphaericus, . . . E. A. Birge. Notes on Clad. (1878), pp. 23-24; pl. II, fig. 19.

Chydorus sphaericus, . . . S. A. Forbes. On Some Lake Superior Entom., (1890), p. 712.

Chydorus sphaericus, . . . C. L. Herrick. Micro. Entom. Minn. Geol. Surv. (1879), p. 108, pl. XIII. Final Report Minn. Crust. (1884), p. 116; pl. F, figs. 4, 7, 8, 10.

Chydorus sphaericus, . . . C. H. Turner. Notes on Clad., Cop., Ost. and Rot. of Cin'ti. (1892), p. 69. Add. Notes on Clad. and Ost. of Cincinnati, O., p. 6.

Length, 0.36 mm.-0.42 mm.; height, 0.31 mm.-0.36 mm.

Habitat: Atlanta, Ga., South River Slough, Mrs. Reeves' Pond, Water Works Pond. This species occurs here at all seasons.

EXPLANATION OF PLATES.

PLATE VII.

Fig. 1. *Cypria exculpta*, Fischer. Lateral view of the shell of a young specimen.

Fig. 2. *Cypria exculpta*, Fischer. Second foot.

Fig. 3. " " Lateral view.

Fig. 4. " " First foot.

Fig. 5. " " Shell markings.

Fig. 6. " " Antenna.

Fig. 7. " " Post-abdomen.

Fig. 8. " " Second maxillae of male.

Fig. 9. *Cyclocypris laevis*, Müller. Antenna.
Fig. 10. " " Post-abdomen.
Fig. 11. " " Second foot.
Fig. 12. *Bosmina atlantaensis*,sp. n. Entire.
Fig. 13. " " Post-abdomen.
Fig. 14. *Cypris burlingtonensis*, sp. n. Antennule.
Fig. 15. " " Bit of shell.
Fig. 16. " " Tip of 1st maxilla.
Fig. 17. " " Dorsal view.
Fig. 18. " " Mandible.
Fig. 19. " " Post-abdomen.
Fig. 20. " " Antenna.
Fig. 21. " " First foot.
Fig. 22. " " Lateral view.
Fig. 23. " " Second foot.

PLATE VIII.

Fig. 24. *Candona Crogmaniana*, sp. n. Mandibular teeth.
Fig. 25. " " Antenna.
Fig. 26. " " Sensory seta from Mandibular palp.
Fig. 27. " " Antennule.
Fig. 28. " " Post-abdomen.
Fig. 29. " " First foot.
Fig. 30. " " Tip of Second foot.
Fig. 31. " " Mandibular palp.
Fig. 32. " " Dorsal view.
Fig. 33. " " Lateral view.
Fig. 34. *Candona acuminator*,Fischer. Post-abdomen.
Fig. 35. *Candona delawarensis*, sp. n. First maxilla.
Fig. 36. " " Post-abdomen.
Fig. 37. " " Dorsal view.
Fig. 38. " " Ventral view.
Fig. 39. " " Lateral view.
Fig. 40. " " Antenna
Fig. 41. *Cypris fuscata*, (Jurine). First maxilla.
Fig. 42. " " Antenna.
Fig. 43. " " Second foot.
Fig. 44. " " Mandible.
Fig. 45. " " First foot.
Fig. 46. " " Post-abdomen.

IV.

ELECTRICITY AS A LABORATORY SERVANT.

A. D. Cole.

Electricity was born in the laboratory. It passed its childhood there and we watched the development of its unsuspected powers with ever increasing interest and expectation. Now it has become a man and gone forth from its early home to strive mightily in the world's work. We may profitably open our doors to it again that it may assist us in carrying on the general work of the laboratory. We may not set it apart for study in the physicist's work-room, but treat it as a convenient agent for doing many kinds of work in chemical, geological and biological as well as physical laboratories.

Think of the numerous uses for motors under perfect control; the physicist desires to rotate his whirling table, his color discs and his sirens by their means; the chemist would use them to exhaust for his filtrations, stir solutions in his absence, crush his ores and grind his powders; the lithologist desires them for polishing his rock sections and dressing his specimens. Then we all want electric light, some for projecting lanterns, some for illuminating microscopic slides, some for exploring cavities and organs otherwise incapable of illumination, some for photographic dark-rooms. And how numerous the possibilities suggested by the fact, that we can electrically generate heat *just where we want it* and keep it away from neighboring parts which we desire to keep cool. The physicist must have it for measuring coefficients of expansion, the chemist for heating one vessel within another that must be kept cooler than itself, also for distilling highly inflammable substances; the biologist finds it convenient for his incubator and his cultures of

bacteria, the botanist may stimulate plant growth by it, the physiologist has numerous uses for it. Then we all need electricity itself; the neurologist traces nerves by means of it, the chemist finds every few days a new method of analysis by electrolysis that he must needs try, the electrical furnace is rapidly opening new possibilities both to him and to the mineralogist, and the physicist demands it in many forms and quantities. How can we get it? Cheaply if possible; conveniently any way, for we live in a hurry.

The primary battery, the earliest generator of current electricity discovered, still holds its place as the most convenient source of electricity for many laboratory uses. The old Grove and Bunsen batteries have never been excelled by newer forms in the combination of two good qualities difficult to obtain in a primary battery, viz: high and uniform electro-motive force and low internal resistance. But they cannot be said to be convenient, for they must be set up anew every time they are used and the chemicals employed in them are expensive and disagreeable to handle. For such reasons these otherwise excellent batteries have a very limited field of usefulness in the laboratory.

For the occasional supply of a current of limited amount the many forms of Leclanche battery and some of the so-called dry batteries—such as are commonly used for electric bells—are very convenient. The convenience lies in the fact that when once set up, they require no attention, with moderate use, for six months or more, as there is no waste of materials when not in use. They are not commonly used for strictly laboratory purposes except in electrical testing, yet we have found them generally useful when used in connection with a simple device for adapting the voltage and resistance of the battery to the work to be done by it. Battery cells are usually so made that it is inconvenient to change their arrangement. Hence they are connected permanently and used for different purposes, although much better results can often be obtained by an arrangement specially suited to the work in hand.

To get the largest current from a battery, its internal resisttance should be made equal to that of the circuit through which it is to send current. We can readily change the internal resistance of a battery if it is convenient to alter the cell arrangement. To overcome the difficulty of making this adjustment in the ordinary battery, the device referred to has been found useful in the laboratory. It is described fully in the Bulletin of the Scientific Laboratories of Denison University, Vol. V, p. 16. In explaining it briefly here, I will recall several fundamental facts. A battery is arranged *in series* when its several cells are connected with the positive of one to the negative of the next, so that the whole current traverses every cell; a battery is arranged *in parallel* when all its positive plates are connected together, and all of its negative plates together, so that with 10 cells, for instance, each cell is traversed by one tenth only of the whole current. In a mixed arrangement several groups of cells, each with parallel arrangement, are themselves connected in series. Now with ten cells in series the resistance of the battery is 10 times that of a single cell, while with parallel connection only 1-10 that of a single cell. With mixed arrangement we may secure a variety of intermediate internal resistances.

The cell-arranger consists of a number of pieces of metal arranged in two rows on an insulating support. Each one is permanently connected by a wire with one pole of a battery cell. The pieces attached to the positive poles (call them *a b c d* etc) are in one row, those of the negative poles (call them *m n o p* etc) in the other. They must be so placed that we can readily make connection by a plug or a switch as follows: *a* with either *b* or *n*, *b* with either *c* or *o*, *c* with *d* or *p* etc. Wires for conveying the current to the apparatus are attached to *m* and to the last piece in the positive row.

With this accessory, a battery of six to ten open circuit cells, can be made to deliver weak currents at high voltage or may rival the chromic acid plunge battery—which is undoubtedly the reigning favorite in the laboratory—in giving strong

currents (say 10 to 15 amperes) through low resistances. It has the additional advantage of requiring absolutely no attention for many months when once put in operation, no handling of strong corrosive acids in setting it up, and a minimum of labor and inconvenience in renewing the zincs.

We have had in operation in our laboratory for several years three modifications of this cell arranger: one with plugs connecting brass blocks mounted on a vulcanite plate, another with the plugs replaced by sliding switches of spring brass, a third having the brass blocks replaced by screw cups connected by short wires. The instrument with plugs is surest in its contacts and quick in operation, but the most expensive of the three ; the second is quickest in operation, the third simplest in construction.

If constancy for long periods is the main consideration, the gravity, Daniel (or telegraph) battery is largely used. Its great defect of feeble current can be largely overcome by having a considerable number of cells controlled by a cell-arranger. Thus a battery of 20 cells, which can give at most but 1-5 ampere with the ordinary series arrangement, may give nearly 20 times as much by use of the cell-arranger.

It is a very great advantage to the overworked teacher or investigator if he is able, by a little more labor at the outset, —say in vacation time—to have an apparatus so easily managed that he may, at a moment's notice, always have his battery properly arranged for a new duty. I suppose it is due to the considerable labor of changing connections in an ordinary battery that so general a disregard and even ignorance, of the simple principles of best action in a battery prevails. I should judge that such an arrangement would be especially valuable in the study of nerve stimulation as it gives such ready control of the voltages applied. I can testify particularly to its convenience in different kinds of electrical testing.

But all of the batteries thus far considered *fail* in this respect ; their electrical properties do not remain constant. We can not be sure that we can exactly reproduce the result today which

we obtained yesterday, with the same battery. The ideal battery is constant in voltage and resistance whether giving a small or great current. To be also efficient and convenient, it must have a very low resistance. Among commercial batteries, the one that most nearly fulfills these conditions is probably the Edison-Lalande. It delivers a large current and at a constant rate, but has the disadvantage of low voltage, requiring therefore a greater number of cells. It is largely used for running phonograph and fan motors.

The secondary or storage battery has a lower internal resistance than any primary battery, and is therefore capable of giving a very heavy current. It is often charged by a constant primary battery of feeble power, working continuously through the long intervals between short periods of use. Thus a gravity battery of 10 cells may be used to charge 3 cells of storage battery. The primary battery itself would give a current of only 1-10 to 1-5 ampere through even a low resistance, while the storage battery charged by it will restore the electrical energy at a rate as high as 15 amperes. Moreover we can predict almost with certainty just what it will do on a given circuit. It must be confessed however, that storage batteries do not work as well when charged in this slow way as when charged by a dynamo. There is a tendency to the formation of lead sulphate in the cell which interferes with its action. The result can be partially prevented by introducing sodium sulphate, either directly or by the action of the battery acid on sodium carbonate. Even without this addition, I have found this method of charging a few storage cells a great convenience in the physical laboratory.

Small dynamo machines, run by hand, are often convenient in the laboratory, but their output is too variable and uncertain to adapt them to any exact work, and the source of their energy evidently unfits them for supplying current for many minutes at a time.

But electricity cannot reach the full measure of its useful-

ness in the laboratory unless current can be drawn, directly or indirectly, from a power dynamo. And here it may indeed become a general laboratory convenience. Those are especially fortunate whose laboratories are equipped with direct current incandescent lamps. Such can very easily have all the luxuries that have been mentioned. Motors from 1-12 horse power up, that run at a perfectly constant speed under varying load are common trade articles; the numerous special uses of the incandescent lamp are directly provided for; arc lamps for projection purposes, adapted to such circuits, have reached a high state of perfection and from the known voltage it is easy for any electrician to calculate just what kind of a coil of wire will produce any required heating effect. The voltage of such light mains is too high for many purposes, such e. g., as chemical analysis, and for use with most of our demonstration apparatus whose coils have been constructed for the low voltages of primary batteries. But it can be reduced conveniently in several ways. First, by use of an extra resistance with it; this is not economical in the use of current, but is simple and easily controlled. Second, by using a motor adapted to this voltage to run a dynamo wound to give the desired kind of current; this involves the use of two expensive machines. Some expense and space may be saved by combining them in one apparatus—the motor-dynamo, or dynamo with a double winding on its armature. Third, by running the currents used for lighting the building, or for other moderately constant uses, through a few cells of storage battery, using this for low voltage currents. This seems the best way. It is equally applicable to the case of those laboratories not connected with electric light mains that have their own dynamo running but only a part of the time. The storage battery can then be available for many purposes when the dynamo is idle. For instance, suppose the dynamo generates current at 110 volts, instead of using 110 volt lamps, we may use 90 volt lamps running the current for them through about 10 cells of storage battery. If we use an average say of 20 lamps 10

hours a week, from a dynamo we would be able to draw about ¼ horse power of energy (as light, heat or power) from the storage cells for the same number of hours. In this way the inconvenience of using primary batteries about the laboratory can be largely avoided.

A simple plan for a dynamo and storage battery outfit would be to have a constant-potential dynamo of about 50 volts and a storage battery of the same voltage with motors, lamps and general apparatus all adapted to this pressure, to run the dynamo at full capacity as much time as may be necessary to charge the battery (doing other work at the same time,) and to use the storage battery alone for the general work of the laboratory at other times. For a large laboratory building, a combination of the two plans would be useful. Use a dynamo of higher potential, say 110 volts, for the general work of the laboratory, at least all heavier work such as supplying power for mechanical workshops etc ; let the dynamo at the same time charge a 55 volt battery and run 55 volt apparatus placed in series with it in the special rooms most likely to be used at odd times when it is not convenient to have the dynamo running. The lamps and apparatus can then be used at any time when the machinery is idle by means of the storage battery. This is the plan now being introduced in the new Barney Laboratory of this college. There remains the case of the laboratory equipped with alternating current. Light either from incandescent or arc lamps is directly provided for. All heating effects can be produced as well by such currents—a class of uses which will doubtless become very much extended in the near future. For charging storage cells and for use with most demonstration apparatus alternating currents are not suited, but alternating motors might run direct-current generators to supply the current for such purposes.

All that has been said of alternating currents will apply to the three-phase and multiphase currents now being introduced for conveying power and light to a distance, but such currents

are not likely to be supplied to laboratory buildings for some time except as they may be required in physical laboratories for study of the currents themselves.

There seems to be an increasing demand in laboratories for conveniencies and special facilities. A constantly increasing proportion of the science work has to be done by laboratory methods, while there is often no corresponding increase in the number of instructors and assistants. It is hoped that this paper may prove useful to some in devising ways of making their laboratories more efficient without thereby increasing their own cares and labors.

V.

A CONTRIBUTION TO THE KNOWLEDGE OF THE PREGLACIAL DRAINAGE OF OHIO.

PART I.

W. G. TIGHT.

CONTENTS.

1. Introduction.
2. The Topography and Present Drainage of Licking County.
3. The Present Channel of the Licking River.
4. Evidence of a Buried Channel North of the Present Licking River.
5. The Present Muskingum Valley.
6. The Course of the Preglacial Muskingum.
7. Probable Causes which Produced the Changes in the Drainage of the Muskingum and Licking Rivers.
8. Relation of the Preglacial Muskingum Drainage to the Other Drainage Systems of Ohio.
9. The Hocking River and its Tributaries.
10. The Scioto River; Characters of its Upper and Lower Portions.
11. The Miami Drainage Channels and the Character of the Topography of that Region.
12. Evidence of a Buried Channel to the Northwest.
13. The Southern Tributaries of the Ohio River.
14. The Character of the Ohio River Gorge.
15. Conclusions and Theoretical Considerations.

1. INTRODUCTION.

The facts presented in this article have been largely collected during the last two years in connection with the geological work and field excursions of the various classes in geology in Denison University. Various members of the Senior class of 1894 have assisted in the work in the region around Hanover and

Toboso. At the winter meeting of the Ohio State Academy of Science the outline of part of this paper was presented and certain conclusions were suggested. Since that meeting many new facts have been collected which have considerably modified the conclusions there presented. The facts given at that time have been carefully re-established. The order of presentation is that followed in the field work and investigations. The principal lines of evidence employed may be grouped under two heads—Topographical and Structural.

Under the topographical is included the present surface topography, its particular form and elevation; the topography of the rock surface as indicated by exposures and well borings. Under the structural is included the geological formation of the rock and the character of the glacial drift.

2. Topography and Present Drainage of Licking County.

Licking county lies near the centre of Ohio and its present drainage is by the Licking river, which is formed at Newark by the confluence of three streams, the North and South Forks and Raccoon creek. These streams form a hydrographical basin which is very nearly co-extensive with the county lines. Raccoon creek and the larger tributaries of North Fork rise in the northwestern portion which is a rather high, undulating table land, 1314 feet A. T. They flow through rather broad and open valleys ranging from one half to one mile in width between the Waverly hills. The valleys are filled with drift to a depth of 100 to 150 feet, increasing in depth as we pass down stream until at Newark the gas well borings show a valley filling of over 300 feet, making the rock floor of the old valley about 500 feet A. T.

These two streams are of rapid fall, descending 350 to 400 feet in the 40 to 50 miles of their lengths. The South Fork rises on high ground in the southwestern portion of the county, flows south and east to near the Licking Reservoir, which lies about 125 feet above Newark, or 944 feet A. T. From this

point the water course is almost due north to Newark. Along the east side of the lower part of both the North and South Forks the hills rise rapidly to an elevation of about 250 to 300 feet above the river. Standing on these hills and looking west the country seems to gradually rise and no very high hills appear in this direction. A level however reveals the fact that the land to the west is nearly as high, but is so filled in with drift that only the tops of the hills appear above the general level. The surface rock of the western half of the county is wholly of the Waverly group. This rock surface is covered to a greater or less depth with glacial clays and occasional pockets of assorted gravel.

The valleys of the North Fork from the north and Raccoon creek from the west are evidently preglacial as is shown by their great breadths, their gently sloping hillsides of Waverly rock and their great depth as indicated by the drift filling. In all of these valleys are beautifully developed gravel terraces rising in steps from the streams to the bordering hills. The well sections made in the valley filling are quite various, showing alternating beds of yellow and blue clay and sand, gravel and quicksand. The preglacial channel of the North Fork probably extended into Knox county and received the head waters of Owl creek and is much the larger of the two valleys.

In the "Report of the Geology of Licking County," Ohio Geological Survey, Vol. III, page 348, Mr. Read speaks of this preglacial channel and says: "At Newark it divides; one branch turning directly to the east, in the valley of Licking river and one branch extending northwesterly through what was evidently at one period a broad lake, and in which now the south branch of the Licking flows with a reversed current to join the main stream at Newark." Mr. Read evidently meant "southwesterly" for one branch of this channel, as will be seen by consulting the map Plate III. It would naturally be inferred that the other braneh "in the valley of Licking river" continued throughout the course of the river. The Licking,

however, enters a narrow gorge a few miles east of Newark even before it leaves the county limits. No attempt is made in Mr. Read's work to correlate these preglacial channels.

The South Fork of the Licking flows with a sluggish current over a broad alluvial plain which is covered with a black lacustrine deposit of several feet in thickness. This is especially true of that portion lying between the Licking Reservoir and Newark. We have suggested the name Lake Licking for the body of water in which these deposits were made and of which the original lake in the Reservoir was a part, occupying a large kettle-hole in the drift when the main body of water was drained away.

The topography of the county east of North Fork and South Fork of the Licking is generally hilly. The hill tops represent a base level plain sloping slightly to the west. This plain is much cut up and the high pointed hills capped with carboniferous sandstone are 1150 to 1300 feet A. T. while the present valley at Newark is about 800 feet A. T.

3. The Present Channel of Licking River.

The great valley filling at Newark indicating as it does the depth of the old valley floor leads to the inquiry as to its preglacial outlet. The present streams flowing from the north, south and west meet near the centre of the county and start due east. Plate IV represents at the left hand margin the confluence at Newark. The heavy dotted line indicates the position of the rocky hills. For a few miles east of Newark the Licking flows on the southern side of a broad valley which is filled with heavy drift accumulations on the north side as indicated by the dotted portions on the plate. The relative thickness of the deposit is indicated by the density of the shading.

This valley is occupied by the P. C. & St. L. Railroad, the Ohio Canal and the B. & O. Railroad. About seven miles below Newark the drift reaches such a thickness on the north side and extends into the valley so far that it reaches across to

the rocky island indicated on the plate southwest of Hanover, thus causing the present valley to narrow rapidly. The canal follows along the margin of this higher ground where it reaches to the flood plain of the river. A few miles below Claylick the canal enters the river for the valley has now become so narrow that there is not room for the two. The river here leaves its open valley and enters the hill country in a narrow gorge with perpendicular walls 50 to 100 feet high and the hill tops only a few hundred feet back, on either side rising 300 feet higher. This gorge is commonly known as the Licking Narrows.

In the first mile of this narrow cut there are two or three large curves but the gorge is on an average about 500 feet wide and confines the river in narrow limits. The Baltimore and Ohio Railroad makes many rock cuts in order to get along on the south side and there is scarcely room for the tow path of the canal on the north side.

The left hand margin of the map, plate I, represents the river at the centre of the last curve of this mile of gorge. The walls at X are 45 feet high and overhanging, showing a large amount of undercutting on the curve. On the opposite side of the river the wall is 40 feet high and at XX there is a low shelf about 10 feet high which projects a little beyond the vertical wall on this side. The heavy shaded line represents the outcrop of the Waverly or Logan conglomerate and wherever exposed presents an escarpment with an elevation represented by the figures on the contour lines.[1]

The last curve of the gorge referred to above extends to about O and P at which point the curve of the next sigmoid begins. The gorge runs on past L m to the centre of the next curve at OO, completing the curve at the point n. The river however, does not follow this course as will be seen by fol-

---

[1]All vertical measurements in the description of this gorge are from the water level in the river which is constant on account of the dam below, and is about 776 feet A. T.

lowing the shaded portion which represents the present river course, but turns at a right angle and runs through a rock cut 150 feet wide, with overhanging walls at both g and ć. Just south of ć the railroad has made a rock cut 45 feet deep on a very sharp curve in order to get through the gorge. The rock g, known as Black Hand Rock, stands out with a bold front 45 feet high and 250 feet long next to the river, where the tow path for the canal had to be blasted out. The rock slopes on top towards the north and presents an overhanging wall about 20 feet high on that side.

Within the large open area of the unoccupied curve north of g there is a low mass of rock, presenting the form indicated at m with a vertical rock exposure 10 feet high on the south side of the mass and gradually falling off into the lower channel OO which is only 4 to 5 feet above water level. At n and between g and m are ponds of water on a level with the water of the river. The channel between g and m is about 70 feet wide while that between m and L is 200 feet also between g and the vertical cliff H on the east side of the channel is 290 feet. It is stated by some of the oldest inhabitants that before the canal was constructed part of the river water occupied the channel between g and m during high freshets.

Continuing the large curve L, OO, n southward to R, there is on the east side a long straight bluff SS 45 feet high at the present river front and gradually decreasing to about 8 feet at its southern end. On the high ground between X and this channel there is a light drift covering as indicated by the dotted portion. This drift covers the west wall of the channel except at Y where the rock is exposed. The drift is largely gravel and that part which fills this channel is composed almost entirely of fine sand. At YY there is no escarpment but the high hill presents a very distinct curve as is shown by the contour lines. Between Y, YY, Z and the double cross there is a low drift plain with a form shown by the contours. The river does not follow this low gap which is nowhere over 15 feet above its

present level but has cut a channel through the rocky spur H and S 300 feet wide and 45 feet deep to the present water level. The river here has about 30 feet of water. At K is a rock with 25 feet vertical front and at T a rocky projection 45 feet high through which the river has also cut, while there is an open channel 350 feet wide between K and HH obstructed only by a gravel trail 15 feet high extending from K to a low rock exposure at KK.

The rocks S and T are also separated by a channel about 250 feet wide presenting vertical walls for a short distance back from the river, and indicated farther south by a depression in the drift filling.

At FF is a high hill with a rock cliff 25 feet vertical. At uu there is a low rock wall which is extended to the dam at F. Wells in the drift terrace south of w show a buried channel there 50 to 75 feet deep.

By tracing out the curves and sigmoids indicated by these rocky walls evidence is found for two distinct rock gorges besides the one occupied by the present river as shown by the heavy, dotted and broken lines respectively.

To make these data as clear as possible five sections drawn to scale are presented in Plate II. These sections are taken along the lines bearing the same letters on the map and in the same position. The continuous, interrupted and crossed lines represent the courses of the rocky gorges, while the dotted portions represent the estimated depths of the drift filled channels. The line a on both Plates I and II begins at a, as shown by the contours, at the top of a hill 400 feet high ; descends rapidly to L where it drops down the vertical wall 45 feet ; crosses the sand filled channel to the rock m which rises 10 feet ; crosses the channel between m and g; rises 40 feet to the top of g and extends 200 across its top ; drops 40 feet into the channel at n ; rises 45 feet onto the slightly overhanging rock H ; drops again into the vacant channel between H and K ; passes off from K, which is 25 feet high onto a low drift plain which ex-

tends to the river at the dam : crosses the river onto the rock again beyond F.

Section b shows the river channel between O and P ; the old channel at R ; the rocky spurs S and T separated by the drift channel ; the broad channel between T and uu occupied by the pond u ; the rock wall at uu and the gravel terrace w.

Section c starts in the river where it enters the map and shows the overhanging wall at X with the high drift covered divide to the rock expose at Y and the low rock wall on the opposite side of the channel ; the lowest point in the drift plain at z and the gravel terrace beyond.

Section d taken at right angles to the three preceding begins at d on a hill 150 feet high, descends a vertical wall 45 feet at b into the channel OO ; crosses the low rock mass m and the channel between m and g ; shows the overhanging character of the narrow gorge between g and ć and the elevation at which the river must have began to cut for this channel above the open channel at OO ; the railroad cut and lastly the high drift covered area between X and Y.

The section e shows especially the channel between HH and K and the bold front presented to the river by the rock T at á. Similar vertical fronts are presented by the rocks Ḣ and S.

The river throughout its entire length in this gorge is flowing on rock bottom.

Below Toboso, Plate IV, the gorge opens out into a large basin shaped valley which narrows again at Claypole. The canal leaves the river at Toboso and after passing down the Licking valley to Nashport passes through a gap between the rocky hills to the north and enters a great open valley which it follows to the present Muskingum valley at Dresden.

Beyond Claypole the Licking valley again broadens some what, but rapidly narrows below Irville. At the great curve south of Irville, where the river turns southeast, the B. & O. railroad has made a rock cut on the south side of the river and

on the north side there is a rock cliff 150 feet high. This is the narrowest place in the valley between Toboso and Zanesville, but below this evident ancient col the valley of the Licking is still very narrow. At Dillon's Falls, as well as at Toboso, the river is running on a rocky floor. It is barely possible that at the Falls there may be a deeper valley to one side, but a rather hasty examination revealed no evidence of such a channel.

These considerations make it very evident that the present Licking river could not have been the line of drainage for the ancient basin at Newark, but must be considered as postglacial.

4. Evidence of a Buried Channel North of the Present Licking River.

The great width of that portion of the Licking valley immediately east of Newark and the suddenness with which the river leaves this open valley is very suggestive as to its eastern continuation.

The line of Waverly hills capped with carboniferous sandstone, which form the northern wall of this broad valley, and over which the drift accumulations which fill that portion of the valley were evidently poured, can be traced as an unbroken ridge to the east along the line indicated by the heavy dotted line in Plate IV. It is divided north of Hanover by Rocky Fork Creek and north of Frazersburg by Wakalomaka Creek, both small streams with narrow V shaped valleys. Where Rocky Fork breaks through this line of hills it emerges onto a great plain which extends unbroken, but gradually ascending, in the direction of Newark. After crossing this plain it enters a narrow gorge at Hanover which it traverses for about one half mile and then emerges onto the flood plain of the Licking River. On the east side of the stream between the hills on the north and the Hanover gorge, there is a great drift accumulation, Plate IV, D, which presents a steep front to the west and rises 150 feet above the stream or 971 feet A. T. To the east of D the drift is not quite so high for a short distance and then about midway between D

and M the P. C. & St. L. Railroad has made a cut into the drift, at the point indicated by the heavy dotted area on the map, 75 feet deep. At M the rocky hills are about two miles apart and the valley plain between is so low and marshy that it is with difficulty drained into the Wakalomaka creek.

Just beyond Hanover the railroad has made a rock cut 60 feet deep through a spur of the rocky mass S while a well sunk 100 yards to the north revealed the fact that with that much deviation no rock would have been encountered.

At w about one mile east of Hanover and only a short distance into the valley from the rocky hill S a well sunk 218 feet passed through sand, gravel and clay but did not strike the rock. It is very probable that the rock floor is much deeper midway between the hills. The bottom of the well extends about 150 feet below the present level of the Muskingum at Dresden. As rock was not reached the greatest depth of the floor of the old valley is not known.

The drift is composed largely of sand and gravel deposited in broad sheets and as it is near the margin of the glaciated area it seems quite reasonable to suppose that the western edge of this deposit between the hills at Hanover represents the position of the ice front and that the deposit was made from the glacial waters flowing east along the broad valley, and extended only to the swamp land. Other facts also locate the limit of the ice sheet very close to this point.

East of the swampy area M and Frazersburg there extends a broad valley two miles wide bordered with gently sloping hill sides and with almost a level flood plain over which the very small stream Wakalomaka creek meanders with a very sluggish current to join the Muskingum at Dresden. Between this old valley and the present Licking river there are three low gaps. Through the eastern one the canal finds its exit. The conclusion early arrived at was that this ancient valley was that of the preglacial Licking. This was based on the general but

erroneous statements that the Muskingum valley was one of the largest and embraced the richest farming lands in the state.

5. The Present Muskingum Valley.

The Muskingum River formed at Coshocton, Plate III, by the confluence of the Walhonding and the Tuscarawas, flows a little west of south to Zanesville and then a little east of south to the Ohio River, at Marietta. It receives two large streams as tributaries, Willis Creek on the east which rises within 20 miles of the Ohio River and flows with a very sluggish current north and west entering the Muskingum a little below Coshocton, its general direction being parallel but its flow in the opposite direction to that of the Muskingum. The other large tributary is the Licking River which enters from the west at Zanesville through its post-glacial channel. The upper Muskingum Valley at Coshocton is about one and a half to two miles wide and is bounded by hills with a slope of about 25 degrees. A view from Reservoir Hill one mile east of the city shows at a glance that the Tuscarawas is the main axis of drainage and that the Walhonding is a tributary which enters the broad axial valley as a comparatively narrow one. Well borings along the Muskingum and Tuscarawas at Canal Dover and other points show a drift filling of 150 to 200 feet.[1] This valley retains its general form and width as it passes south.

At Dresden the Muskingum River leaves the broad valley at almost a right angle and enters a very much narrower one. Below Dresden at Rock Cut and at Ellis this valley is very narrow and is bounded by precipitous walls of Carboniferous rock.

At Zanesville the valley is so narrow that the city is built upon the hills on each side and the river runs on a rocky floor. The valley to the south never broadens again to equal that of its upper portion, its average width being about one quarter of a mile. At Duncans Falls the river is on a rocky floor. At

---

[1]Geological Survey, Vol. I, page 36.

Blue Rock the valley becomes a veritable gorge and it is with difficulty that the railroad has constructed its roadbed. There are many characters which make it evident that an old col occurs at this point.

At McConnelsville the bluffs facing the river rise almost vertically 350 feet, 1104 feet A.T. The valley is about one quarter of a mile wide and the river is running on a rock bottom. The river here is only 65 feet below its level at Coshocton while it is nearly 100 feet above the bottom of the well in the ancient valley at Hanover. The general rock surface as represented by the adjacent table lands is at least 481 feet above the rock floor of the valley at Coshocton.

It thus becomes evident that the preglacial drainage of the the Tuscarawas and upper Muskingum was not south along its present course below Dresden. The fact that the general rock surface of the country rises as we pass to the south shows that this drainage line has cut its way into this plain by cutting down the margin of a basin.

At Dresden the hills rise 300 feet above the river and give a beautiful view of the broad valley of the Muskingum above that portion of the Muskingum so noted for its rich farms that its reputation has extended to the whole Muskingum, and has left the general but erroneous impression that the valley of the Muskingum was of this broad and open character throughout its entire length. The view from these same hills shows the broad preglacial valley passing on to the west, a continuation of that of the Muskingum, no less rich in its broad acres of bottom land, but one looks in vain for the river which should occupy it. There is seen coming in from the west the small stream, Wakalomaka creek, of insignificant dimensions compared to this great valley. Following up this creek to the west, to a mile beyond Frazeysburg, it turns squarely to the north and enters the hills. Following along the line of the P. C. & St. L. Railroad for a few miles beyond the swamp M, there is presented now a heavy grade and then a great cut into the heap of

drift deposit already referred to. This cut is a mile or so in length and of varying depths until at Hanover the railroad again emerges into the open valley which continued west to Newark.

6. The Course of the Preglacial Muskingum.

The facts already given indicate that preglacial drainage of the upper Muskingum and Tuscarawas valleys, with a depth of 150 feet below the present streams, was through the preglacial Muskingum channel past the morainic dam at Hanover, which has a valley depth at least 150 feet below the Muskingum at Dresden, into the Licking system at Newark, with a valley depth of over 300 feet below the present river. North and west from Newark the valleys are all rock bound and the streams rise in rocky table lands. East, the present Licking river is flowing in a postglacial channel. South, the county is flat and covered with a lacustrine deposit. The divide between the present South Fork of the Licking and the Scioto basin near the Licking Reservoir is about 150 feet above Newark but no rock is exposed in this region. The line of rocky hills extends south from Newark and passes east of the Reservoir and then bends west towards Lancaster.

Gas wells at Thurston and Basil show a depth of drift of over 335 feet. This would make the rock floor in this direction at least 300 feet below the present river drainage at Newark or 584 feet A. T. West of Thurston extends the great drift plain of the Scioto valley and no rock is known in this direction.

This, then, must be considered the direction of outflow for the preglacial basins of the present Licking and Muskingum rivers. Beyond Newark this old valley made a bend to the south and west and entered the Scioto system south of Columbus.

7. Probable Causes which Produced the Changes in the Drainage of the Muskingum and Licking Rivers.

In order to find any satisfactory explanation for the complicated topography of the Licking and Muskingum basins the

whole succession of events accompanying the first advance and final recession of the ice sheet of the Quaternary must be taken into the account; not only the general and widespread results of glacial action but also the local and minor effects produced along the margin and under local portions of the ice lobes. As this region is just on the border line between the glaciated and drift covered portion of the state and the nonglaciated area it would be expected that the minutest detail of glacial action would here be preserved and presented to the best advantage. As it is not intended in this paper to discuss the question as to the particular time in the glacial period when these changes took place no attempt is made to distinguish between the first and second invasion of the ice sheet or to correlate in any way the relations of the drift deposits but only to show the effects of these deposits and the ice sheet itself in modifying the drainage lines. As our investigations began with the study of the Licking Narrows we will first offer an explanation for that particular region.

During the maximum period of ice invasion the eastern border of that sheet which covered central and western Ohio presented a front running north and south through Knox, Licking and Perry Counties nearly coincident with the heavy dotted line on Plate III which represents the line of hills bordering the interior drainage basin. This same range of hills is shown along the North and South Forks of the Licking at the left hand margin of Plate IV. It is evident that when the ice occupied this position it formed a very effectual dam across the preglacial Muskingum valley at Newark. There were two streams draining into this valley from the south, one along the lower course of the Licking below Nashport which emptied into the Muskingum through the gap now occupied by the canal. The other, probably a much larger stream and one which reached farther to the south entered at Dresden.

When the valley was dammed up at Newark the waters of the Muskingum, which was greatly increased in size by addi-

tions to its upper sources with probably a vast river from the ice sheet itself, found an outlet to the south through the gaps between the rocky islands represented on Plate IV down the reversed lower Licking and Muskingum. As the valley of the Muskingum was larger than that of the Licking it carried the main volume of the stream and attained the greatest depth. On account of the wall of drift at the Hanover dam, D, and the stratified deposit filling the valley it has been suggested that a lobe of the ice extended into the valley to this point and the material was deposited from the water flowing from the ice and as it was partially back water it formed a delta-like deposit which only extended to the marshy area, M, back of this dam. Where there was a current between the gaps this deposit was not so deep, as is indicated by the lighter shaded portion.

As already stated the watershed between the South Fork of the Licking and the Scioto basin which extends west along the county line, Plate III, is composed of morainic material. After the retreat of the ice the Licking basin was closed and as the waters rose in Lake Licking before they reached the level of the top of the Reservoir dam or of the Hanover dam, they reached a low col in the divide a little south of Hanover. The position of this col is represented by the present Licking Narrows. Its exact position was probably at the point represented by c at the extreme left of Plates I and II.

On each side of this low divide there was a ravine cut into the Waverly conglomerate. As the water rose over the divide and began to cut it down, the gorge produced by this cutting to the west of the point c conformed exactly to the pre-existing ravine running in that direction as this ravine would represent continuously the lowest point in the divide; hence we find the upper part of the present gorge showing no marked changes in its position.

The ravine on the down slope towards the east, however, whose outline is represented on Plate I by the dotted line and on Plate II by the crossed line, fared quite differently. A

large volume of water suddenly attempted to occupy a small ravine. The result was that the first curvature was greatly increased and a great undercut made at X. Deflected from this point it struck the opposite or left bank of the ravine at M and as it cut farther back into the great curve at OO it also cut deeper and a small remnant of the left bank of the original ravine was left at M. The outline of this channel is represented by the broken line.

After making the curve at OO where considerable undercutting is also shown, the waters took a straight shoot south into the old ravine again. At the south end, at YY, the old ravine, as shown by the dotted lines, made another sharp curve similar to the one at G, and passed north between S and T to another curve at HH, thus making the next loop of the sigmoid which passed southeast through the point u. Since the rush of glacial waters was not able to make the short turn at YY and since the original surface level was lower than at H, they broke over the divide and made a new cross channel tending northeast in the direction Z u and choked up the old ravine between S and T with sediment. As the lower level was reached and the velocity checked the lower courses of the intersected ravine were filled up with material cut from the gorge above. Evidence of these buried channels is found in many wells in the village of Toboso just south of the river dam which is across the present river at F.

There yet remains the great question, why the river ever left this second channel which it had cut out to such a great depth and made a new one for itself straight across the rocky barriers at gé, HS, and KT. If these were at the ends of the loops or if the old channel was anywhere obstructed with drift the explanation would be more simple. As it is there seems to be but one solution to the problem to suggest and we believe the facts very strongly support it. This region is just on the eastern border of the Scioto lobe of the ice sheet. No glacial till is reported south or east of this point in Ohio.

Does it not seem reasonable then to believe that the great ice front or a local spur of it extended to this point and presented a front along a line represented by the north bank of the river in the line of L, m, g, n, H, K, and F, and remained there long enough for the river waters deflected at X to strike this ice barrier at L, m and, deflected along its front to cut through the narrow and jointed rocky spurs at KT, then at HS and last at g ć? If this is true it will serve as a point in evidence of the probability of ice dams and a point to fix a limit to the ice sheet itself.

After passing this gorge the Licking waters found a lower channel along their present course than through the canal gap to the Muskingum at Dresden.

8. Relation of the Preglacial Muskingum Drainage to the Other Drainage Systems of the State.

The recent article by Prof. T. C. Chamberlin and F. Leverett on "Drainage Features of the Upper Ohio Basin." Art. XXIV in the April issue of "The American Journal of Science," presents many facts which have a much wider application than the immediate territory considered. If the conclusions reached in that paper are in the main correct and accumulating evidence seems to point with certain finger in that direction, the question naturally arises: What of the lower Ohio river basin?

If the waters of the Allegheny and Monongahela, with their tributaries should be subtracted from those of the present Ohio the latter would be reduced to about half its present volume. The stream would then be small in comparison with the size of its gorge.

The principal tributaries along the Ohio State boundary which we will designate as the middle Ohio basin would then be the Muskingum, Hocking, Scioto and Miami on the north and and the Kanawha, Big Sandy, and Licking (Kentucky) on the south. These streams represent a hydrographic basin but a little larger than that of the upper basin. If the influence of

the ice sheet was great enough to deflect the drainage to the north into the upper basin of the Ohio and cause the cutting down of the cols illustrated in the article referred to, while the ice itself only invaded a small part of the basin, may we not look for some similar modifications in the middle or Ohio portion of this great river system ?

As the tributaries of the Ohio on the north were more likely to be modified by the ice invasion, these will be considered in their order below the col at New Martinsville which, according to Profs. Chamberlin and Leverett formed the preglacial divide between the upper and middle Ohio basins.

The first large tributary, the Muskingum, as has already been shown certainly did not discharge its waters into the Ohio river at its present location. The sluggish current of Willis Creek, the eastern tributary of the Muskingum is probably due to the filling up of the valley at its mouth. It is probable that the present lower Muskingum was represented in preglacial time by a stream corresponding in the direction of its flow to this creek and was appropriated by the modified glacial and postglacial systems.

9. The Hocking River and its Tributaries.

The Hocking river has its rise on the southern border portion of the great drift plain of the Scioto Valley, but instead of delivering its waters into that system it flows to the southeast and enters the hill country of Fairfield and Hocking counties in a narrow gorge somewhat similar to that of the Licking, and continues to the Ohio in a narrow valley evidently modified by glacial influences. A number of the upper tributaries of the Hocking present the same phenomena of narrow rock gorges where they leave the upper drift plain, which would naturally drain into the Scioto system, and break through the high divide to the Ohio river. These must evidently be considered the channels of glacial rivers from the Scioto lobe of the ice sheet.

10. The Scioto River; Characters of its Upper and Lower Portions.

The Scioto river rises near the northern watershed of the state north of the Bellefontaine highland in Auglaize county, flows east through Hardin into Marion county and then turns south through Delaware, Franklin, Pickaway, Ross, Pike and Scioto counties. The basin of the Scioto is generally low and comparatively level.[1] It has been suggested that the Ohio shales, Plate V, No. 8, are much softer than the other members of the Ohio scale and that they have let down under the influence of disintegrating and eroding agents and have thus determined the lines of drainage and especially that of the Scioto system. If this is true it would seem as though it ought to hold for the southern part of the state as well as the northern and middle portions. The hills of the western portion of Ross, Pike, and Scioto counties rise 1100 to 1200 feet A. T., while the Scioto river leaves the limits of the Ohio shales near Chillicothe and enters the Waverly formation, Plate V, No. 9, and follows its outcrop to the Ohio river, while the Waverly and the outcrop of the Berea grit has been considered one of the most resisting series, and in evidence of that it has been noted that its outcrop has determined the watershed between the Muskingum and Scioto systems and is represented by almost a straight north and south line. The Scioto, however, as stated, leaves the region of the Ohio shales and enters that of the Waverly.

The number of large streams, notably the Whetstone, Alum Creek, Big Walnut and Big Darby, which flow for many miles almost parallel to the Scioto before joining it and all except the Big Darby, without rocky axes separating their channels, seems to indicate that their courses have been determined

---

[1]The watershed separating the hydrographic basins of the southern systems of the state are represented on Plate V by the heavy broken lines.

by other than structural factors. Naturally we turn to the great Scioto lobe of the ice sheet for the explanation.

Considering now the fact that the whole Muskingum basin was, previous to the ice age, a tributary to this system, or rather that the upper course of the Scioto must be counted as a tributary, for the Muskingum basin is very much larger than the Scioto basin and forms the principal source of water supply, the lower course of the present Scioto, provided it was the outlet of this early drainage, should have a valley of larger size and of corresponding form, width and depth to that of its upper portion; of form and width because excavated in the same rocks and almost certainly under similar conditions; of greater depth in order to drain the basin; of larger size because the valley should increase in size towards its mouth.

At Chillicothe where the Scioto makes a bend to the east it enters the Waverly and Carboniferous hills as a valley about two miles wide with hills rising 300 to 500 feet on each side. This valley grows narrower to the south until at County Bridge it is about one-eighth of a mile wide with high, steep faced rocky hills on each side. In many places the side hills present vertical cliffs. At Higby the valley is again very narrow, and also at Piketon where the Scioto Valley R. R. is cut from the rocky bank next the river and the river is at least for part of its width running on rock bottom. South to the Ohio at Portsmouth the average width of the Scioto valley is about one half mile, presenting broad and open places where it receives tributaries of greater or less size and then narrowing again. Thus making it very evident that there is a great disproportion between the size of the valley and the stream occupying it. Unlike the disproportion referred to in the valley at Frazersburg where the small Wakalomaka creek occupies the old Muskingum valley, here the river is too large for the valley and the evidence is all against this being the preglacial outlet of the great interior basin of the Muskingum and Scioto. Here also as in case of the Muskingum and Hocking the general surface of the

country, probably representing the slope of the elevated Cretaceous base level, rises as we pass to the south and the Scioto is flowing in the direction opposite to that of the general slope.

II. The Miami Drainage Channels and the Character of the Topography of that Region.

The Great Miami as has been shown by Dr. Orton and others is flowing in a postglacial channel. The Little Miami presents another example of a small stream occupying a large valley. From Dr. Orton's work it would appear that this was the preglacial valley of the Mad river which has its rise in the Bellefontaine high land and is now deflected into the Great Miami. Mill creek also occupies an old channel. The exact correlation of these old channels in the neighborhood of Cincinnati is not satisfactorily determined. This much is evident, that the valley of the Little Miami presents the characteristics of the oldest of all the channels and if the drainage of the interior basin reached the Ohio river in this vicinity it must have been along this line. If the test of size and form is applied to this channel it does not seem to be a fit outlet to such a great basin and other facts are also opposed to such a course.

From the Ohio river at Portsmouth, Plate V, the watershed between the Scioto basin and the drainage systems of the western portion of the state, runs west parallel to the Ohio into Adams County, then north between Pike and Highland, west through Highland to near Hillsboro, H, then almost due north to the Bellefontaine highlands, B. As far as has been determined this watershed presents an unkroken rocky axis from Portsmouth to a point between Springfield and London. From this point north to the rock elevation at Bellefontaine the drift covers the rocky floor for many miles. It becomes evident, then, that the line of preglacial drainage which will be called preglacial Muskingum drainage must have been deflected to the northwest at least as far as Springfield. The country traversed by this supposed channel is buried with drift in most places to an

unknown depth, and presents a great level drift plain. Rock is not exposed at any point along this line. At London, L, the drift is at least 250 feet deep, making the rock floor there about 700 feet A. T.; at Urbana about 870 feet A. T.

The great valley of the Mad river at Urbana has been described by Prof. Moses[1] as a great basin. It is apparently rock bound on the south and north and drift bound east and west. The drift to the west is piled up to a great depth, being probably the deepest drift in the world. A gas well at St. Paris, Champaign County, penetrated 530 feet of drift.[2] This did not reveal the rock floor so that it is not known how much deeper the filling extends but this would show that it is certainly not more than 650 feet A. T. or 210 feet above the Ohio at Cincinnati while the present Mad River at Urbana is abont 1000 feet A. T. and has about 560 feet fall to the Ohio.

Neglecting the drift then, the general rock surface of the country rises towards the south onto the tablelands of Hamilton County to an elevation of about 1000 feet A. T. This would give a fall of at least 350 feet from the tablelands at Cincinnati to the rock floor at St. Paris, thus showing that all the Miami drainage is, like the other rivers of southern Ohio already referred to, up the general slope of the rock surface. This could be accomplished by a gradual rise of the land at the mouth equal to the rate of river erosion or by cutting down the margin of a basin. We have no evidence of such an uplift at this time hence we conclude that it was due to the latter cause. But however that may be, there appears to be no evidence of a valley of the size and form and depth required to carry the preglacial Muskingum drainage into the Ohio river at any point at or above Cincinnati.

12. Evidence of a Buried Channel to the North West.

Gas wells which penetrate the drift to the west and north-

---

[1]Proceedings of the Central Ohio Scientific Association Vol. I, Pt. 1.

[2]Ohio Geological Survey Vol. VI, Page 276.

west of the St. Paris channel reveal the fact that the rock floor in this direction is very low and as stated by Dr. Orton, "It is obvious that there are possibilities of broad and deep continuous waterways throughout this region."[1] This line of evidence would indicate that the preglacial Muskingum drainage found its outlet from the state through Auglaize and Mercer counties into Indiana. Many wells in the latter state give evidence of the continued low level of the rock floor in that direction.

13. The Southern Tributaries of the Ohio River.

The rivers which enter the Ohio from the south within the limits under consideration all flow from their mountain sources in a direction corresponding to the general slope of the elevated Cretaceous base level and they seem to have taken those courses in consequence of the slope given by the Tertiary uplift entirely independent of the underlying rock structure. As they approach the Ohio their present channels are deep precipitous gorges cut out of the tableland down to the level of the Ohio river.

14. Character of the Ohio River Gorge.

It has been suggested by many writers that the gorge of the Ohio in itself presents many characters which would indicate its recent age. Its precipitous walls of limestone, shales and sandstones testify to the fact that they have not been exposed to the action of disintegrating forces for any great length of time. The overhanging cliffs opposite Portsmouth in the Waverly freestone and shales resemble in no way the old valley forms of the central district. The limestone cliffs around and below Cincinnati on both sides of the river are not especially resisting to disintegrating forces but rather manifest opposite characteristics and yet the upper angles of these cliffs have not rounded to any considerable degree. This portion of the gorge from Cincinnati to the mouth of the Great Miami is postgla-

---

[1]Ohio Geological Survey. Vol. VI, Page 776.

cial as is shown by the work of Prof. J. F. James, but it does not present characters different from many other portions of the Ohio gorge. Again it is evident from a study of the great uplifted Tertiary peneplane that its general slope is to the northwest and that it extends beyond the present position of the Ohio river. To put it in another way the Ohio river has cut out its channel across this side hill.

15. Conclusions and Theoretical Considerations.

In conclusion the following suggestions are offered as expressing the probable condition of the preglacial drainage of the upper eastern portion of the Mississippi basin. The attempt has been made on Plate V to partially represent by the red lines the facts as worked out for the central Ohio region and the course of the preglacial Muskingum. The upper Ohio basin is also shown as given by Profs. Chamberlin and Leverett. The question marks indicate doubtful and unexamined regions and mere suggestions are there offered. An exact register is not attempted but only the principal drainage lines are indicated.

If the considerations of L. G. Westgate[1] are correct, that the post-carboniferous drainage developed an axis, as he thinks, in the direction of the present Ohio between the uplifted area and the northern crystallines which was retained throughout the Cretaceous and Tertiary cycles, that axis of drainage must be looked for along the line of the axis of Lake Erie and the deeply buried Maumee channel. The upper drainage of the present Ohio basin was to the north into this Tertiary Ohio river as described by Profs. Chamberlin and Leverett. Another line of drainage was represented by the Tuscarawas—Muskingum through its preglacial channel past Newark bending slightly to the south below Columbus then to the north in the vicinity of London and Urbana, east of Sidney, then west into Indiana to join the main axis which was flowing south west into the Mississippi.

---

[1]American Geologist. Vol. XI, Page 245.

This preglacial Muskingum drainage received a tributary from the south along the line of the lower postglacial Muskingum gorge comprising probably the waters of the Little Kanahwa region or possibly the latter may have continued up the valley of the Hocking.

Another tributary entered from the south along the lower Scioto, a continuation of the Big Sandy. The present Ohio appropriated a part of this stream from the point of the Ohio at South Point to Portsmouth. Possibly another tributary entered from the Miami region made up from the present Licking of Kentucky and a small stream represented in position by a part of the Ohio above Cincinnati or possibly this drainage set farther to the west and did not enter the preglacial Muskingum. How much further down the Ohio this plan of northern drainage can be applied is not known. The upper eastern Mississippi basin then before the ice invasion consisted of a great river system with its axis corresponding in general with the axis of Lakes Erie and Ontario. It received a great tributary from the south, the preglacial Muskingum and one from the north through Lake Huron. Both of which would form a gradually converging system to the axial valley.

If we were to speculate on the action of the ice sheet in reconstructing this preglacial drainage into that of the present, in a few words it would be about as follows. The great lobes of the glacier conformed largely to the great axes of drainage, one along the axis of Lake Huron, another along that of Lake Erie. As the latter advanced with its load of drift which it was continuously depositing in front of itself it filled up its own drainage line with the accumulations represented in Indiana, and also blocked the outlet of the preglacial Muskingum so that the waters were backed up until they crossed a col to the south in the vicinty of Cincinnati or possibly at Hamilton. Finally a great arm of ice extended south into the Miami and Scioto lobes which produced respectively the great St. Paris accumulation west of the Mad river Urbana basin and the other the drift wall

to the east of this basin. The Scioto lobe found the Ohio shales of the northern watershed a rock easy to erode and so a great low place was ground out of the watershed between the preglacial Muskingum and the main drainage axis to the north, in the region of Marion county. This material was carried to the south and filled up to its present level the great valley of the preglacial Muskingum. Its southward movement was checked by the high hills of the southern bank of this valley, only the low outliers being covered with drift and buried out of sight. To the west the ice extended somewhat over these hills and crossed the present Ohio above Cincinnati causing the deflection and the cutting of the new gorge below the city which was also subsequently invaded. The Scioto lobe on its eastern margin heaped up the drift on which the Licking reservoir is located and thus again dammed the old Muskingum channel. Its last lateral and eastern expression is found in the Hanover dam.

While the ice stood at its maximum great rivers of glacial waters were poured off of the ice sheet, which backed the waters up in all the southern tributaries of the preglacial Muskingum, and the great waters set to the west cutting down one after another of the cols separating these southern basins, and the positions of the lowest gaps were probably represented by nearly the present position of the Ohio river. As these were cut through and the Ohio developed in this region, the same thing was happening in its upper basin. As the channel deepened great rivers from the melting ice developed the channels of the present Muskingum, Hocking, Scioto and the numerous channels in the Miami region by reversed currents. After the retreat of the ice these channels were cut of sufficient depth and the dams at Hanover, the Licking Reservoir, Urbana and St. Paris were of sufficient height so that there could be no return to the preglacial systems. The drift accumulations were so great in the main axial valleys that with the probable assistance of some differential movements the whole upper drain-

age of what I have termed the Tertiary Ohio river was deflected to the east and the St. Lawrence system developed.

We can not close without noting the relation of the restored drainage of Ohio to the underlying rock structure. It becomes very apparent that the present correspondence between the drainage lines of Ohio and the strike of the strata is not related as cause and effect. Such impressions have been gained by a study of the geological map but the field observations do not sustain such an opinion. A glance at Plate V will show that the preglacial drainage is almost directly across the strike line. In fact if we do not consider this restored drainage the position of the present Ohio river is evidently across the strike and the case already noted of the Scioto passing from the Ohio shales into the Waverly at Chillicothe makes us believe that monoclinal valleys are foreign to this region and that differential movements have determined the great drainage systems which have subsequently been modified by glacial action.

The present condition of our investigations leaves many questions to be answered for which further field work must be done. This article is only offered as a beginning in the work.

DESCRIPTION OF PLATES.

Plate I.

Map of the Licking Narrows. The heavy shaded lines indicate the escarpment outcrop of the Waverly or Logan conglomerate. The dotted lines indicate the course of the preglacial ravine. The heavy broken line shows the course of the glacial gorge. The shaded portions represent the present river channel and adjacent ponds. The figures on the contour lines indicate the elevation in feet above the river.

Plate II,

Presents five sections taken in the region of the Licking Narrows along the lines indicated on the map, Plate I, and in the same relative positions, thus making it possible to indicate the lines of the old and new channels.

Plate III.

Map of the Licking and portions of the Muskingum and Scioto drainage. The dotted area represents the drift covered district. The heavy broken lines indicate the lines of rocky hills and valley widths.

Wakalomaka creek should read Wakatomaka creek.

Plate IV.

Map of portions of the Licking and Muskingum rivers in Licking and Muskingum counties. The dotted portions represent the drift, D, Morainic dam, W, well, M, low marshy land. The heavy broken line represents the position of the rocky hills and valley widths.

Wakalomaka creek should read Wakatomaka creek.

Plate V.

Map of Ohio and surrounding region representing in black the political boundaries and present river courses, also the geological scale. The heavy dotted lines indicate the positions of the present watersheds. The estimated preglacial drainage is indicated in red. The question marks indicate that the region has not been investigated by the author with sufficient thoroughness to enable him to speak positively.

Plate A (VI).

The right hand figure shows the Phallus. The left hand figure is a vertical median section of the same. A. Pileus. B. Indusium or Veil. C. Stipe. D. Volva. E. Mycelium. F. Inner wall of Volva. G. Outer wall of Volva. H. Cup or support of the Stipe. This plate is reproduced from a photograph by the author, by the Albertype Co., of New York.

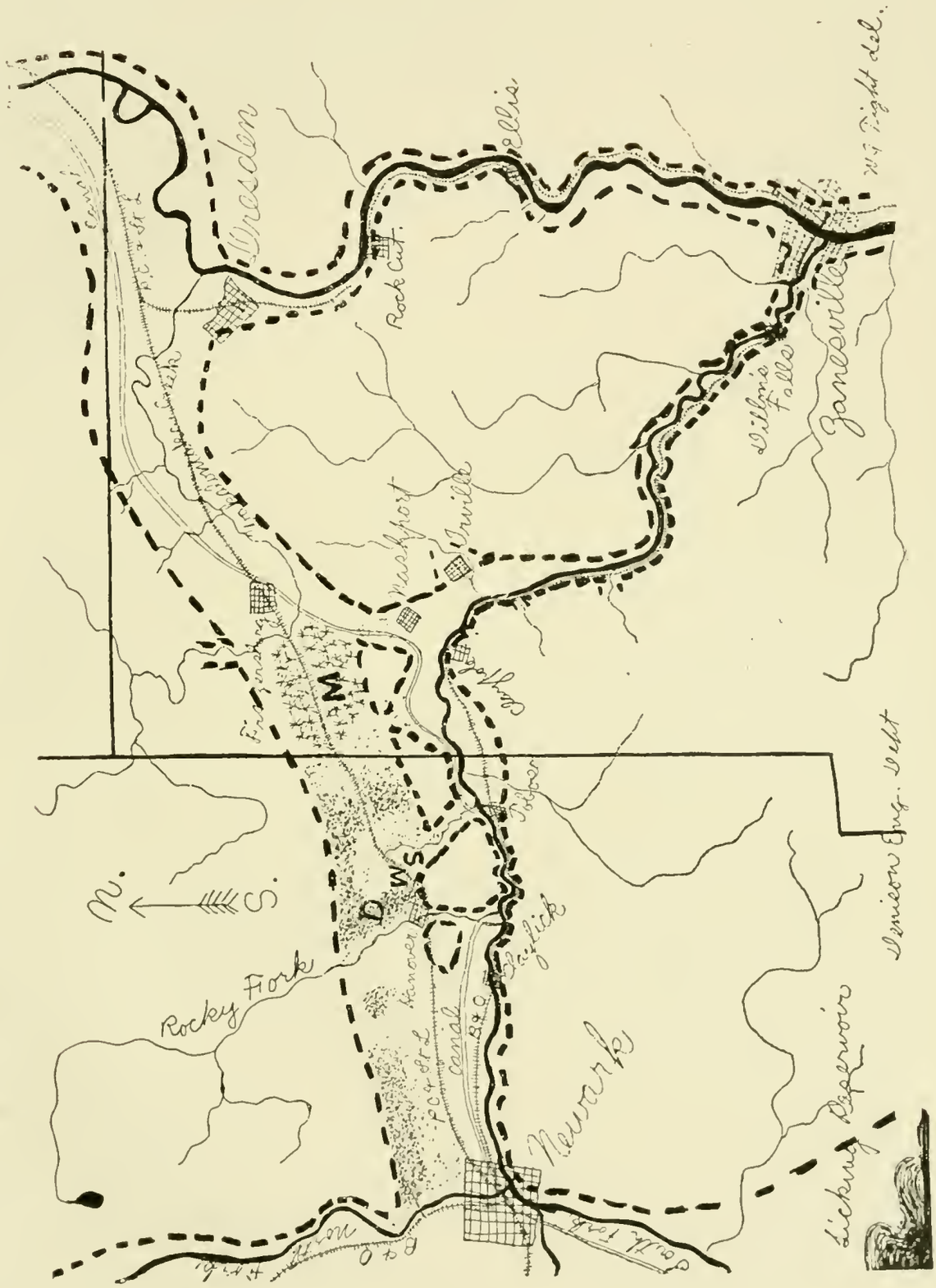
Plate VII, (See pages 25-26).

Plate VIII (See page 26).

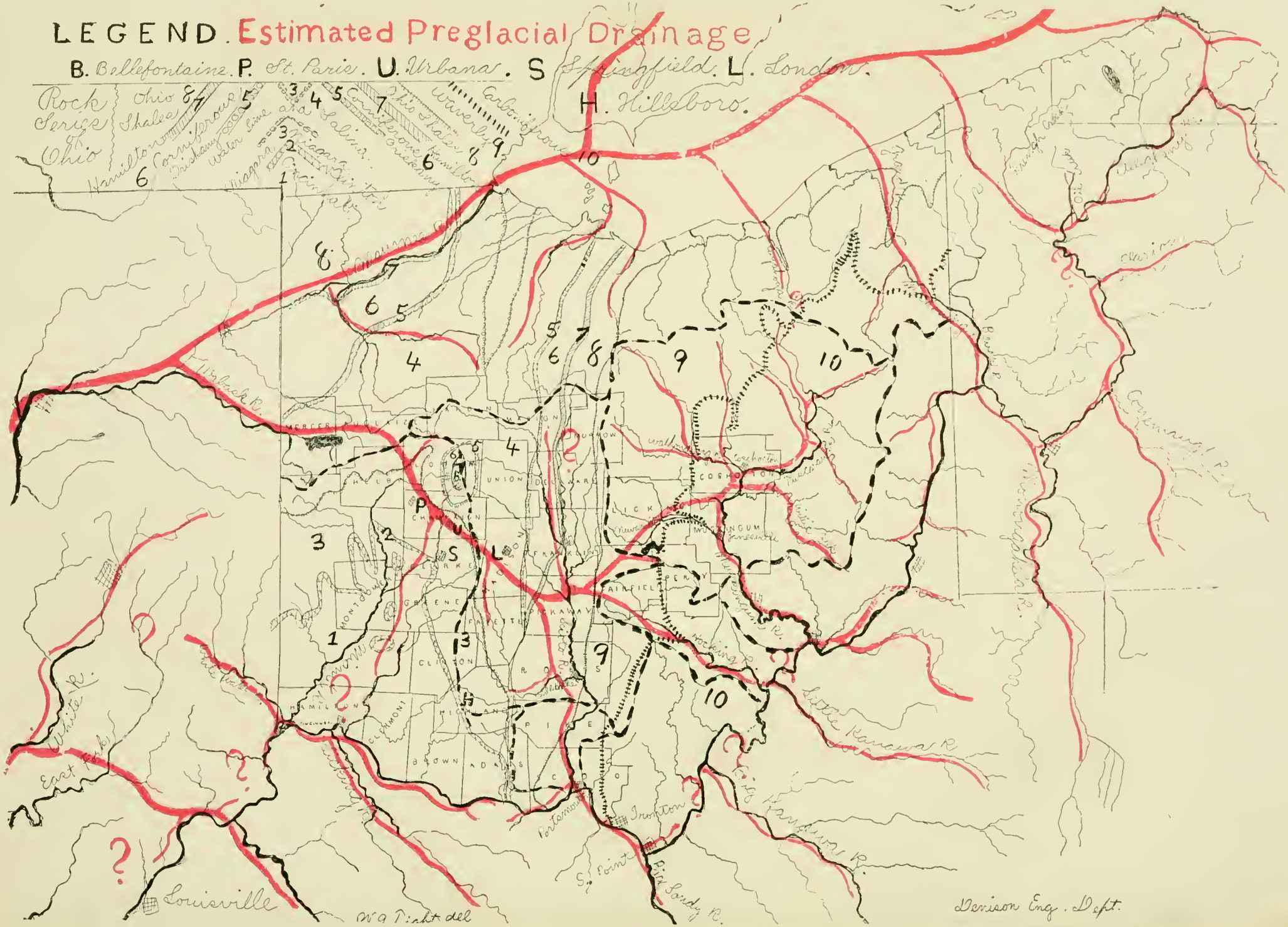
Escarpment of waverly conglomerate.
Drift covered.
Water. R.R.
Contours
Small streams.
Old channels
600 ft. = 1 in.
N.
S.
Dam.
FF.
KK.
HH.
H.
S.
T.
U.
UU.
W.
Z.
YY.
R.
P.
X.
XX.
a.
B.
C.

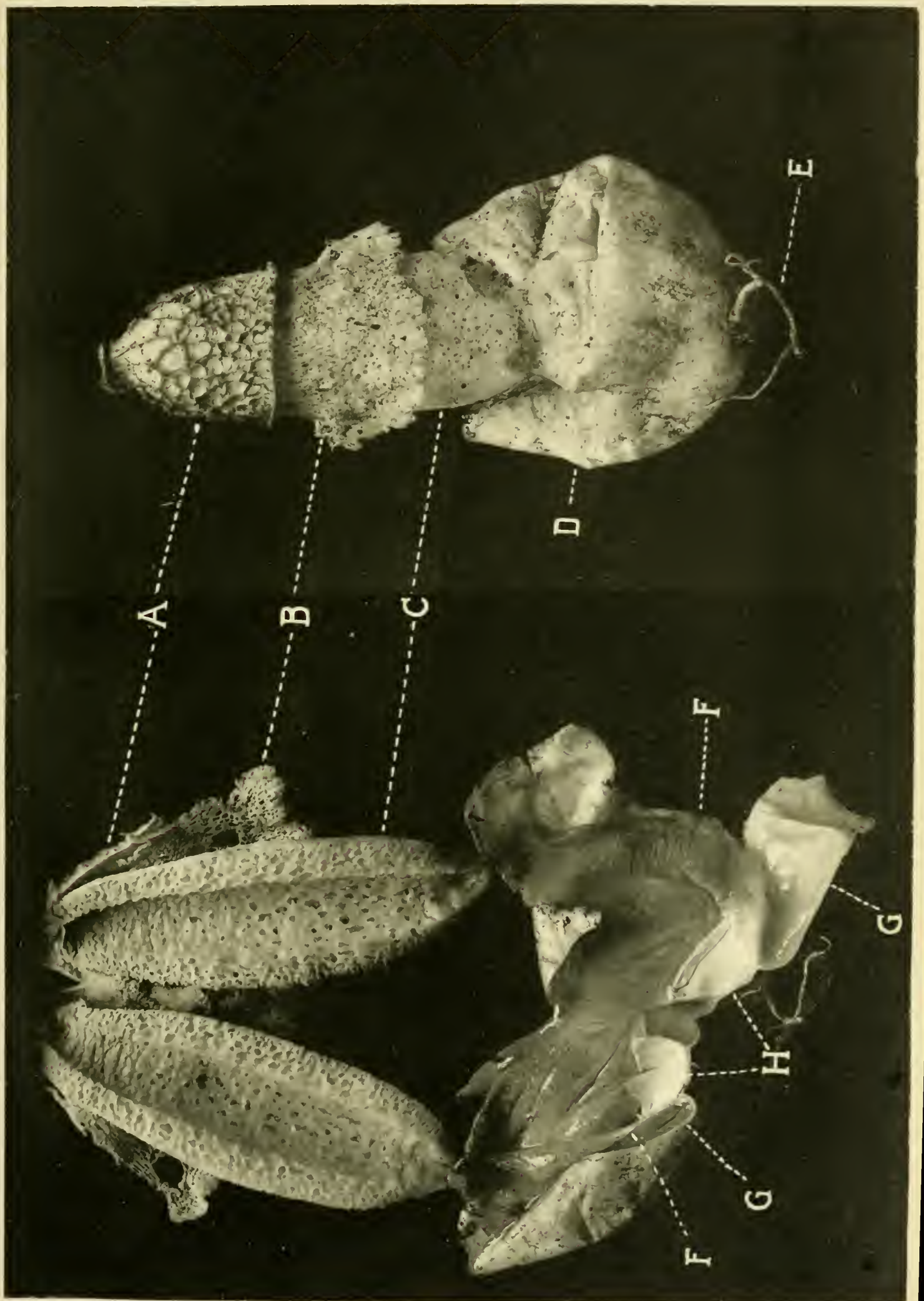
Horizontal scale
600 ft. = 1 in.
Vertical scale
200 ft. = 1 in.
Canal
Surface exposure of Waverly Conglomerate.
Surface of drift.
Estimated rock surface under drift.
Water.
Preglacial gorge.
Glacial "
Present channel.
R.R.C. & E. water level above dams, F. below dam.
R.R. Cut
R.R.
R.R.
W.
N.
S.
H.
K.
L.
P.
O.
X.
Z.
a.
a'
b.
b'
c.
c'
d.
d'
e.
e'
f.
f'
g.
g'
h.
h'
i.
i'
k.
k'
l.
l'
m.
m'
n.
n'
o.
o'
p.
p'
x.
x'
z.
z'

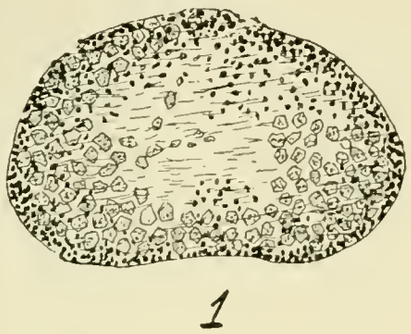
COSHOCTON
KNOX
LICKING
MUSKINGUM
PERRY
MORGAN
FAIRFIELD
HOCKING
DELAWARE
FRANKLIN
PICKAWAY
UNION
MADISON
Coshocton
Dresden
Zanesville
McConnelsville
New Lexington
Mt Vernon
Granville
Newark
Lancaster
Logan
Big Walnut
Walnut Creek
Alum Creek
Delaware
Whetstone
Scioto
Columbus
Circleville
Big Darby
Walhonding
Tuscarawas
Licking
Muskingum
Monday Creek
Hocking
Basil
Thurston
Reservoir
North Fork
South Fork
Raccoon Creek
B & O.
T. & O. C.
P. C. & St. L.
S. V.
N.
S.

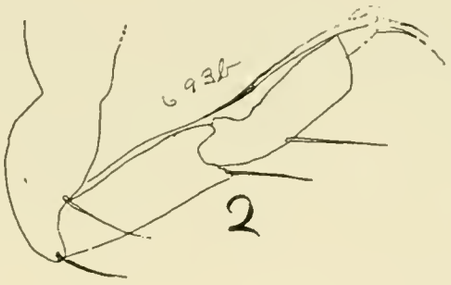

Wrasden
Rock cut.
Ellis
Wilkins Falls
Jamesville
Irville
Moorhead
Dresden
Newark
Rocky Fork
Canal
Licking Reservoir
N.
S.
W.
S.

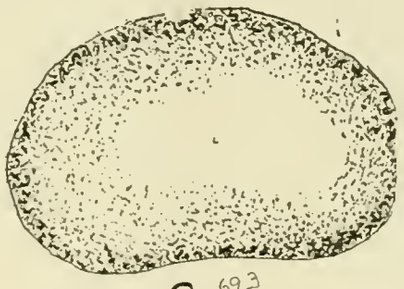
Bulletin Sci. Lab. Denison University. Vol. VIII, Part 2, PLATE V.




A
B
C
D
E
F
G
H
F
G

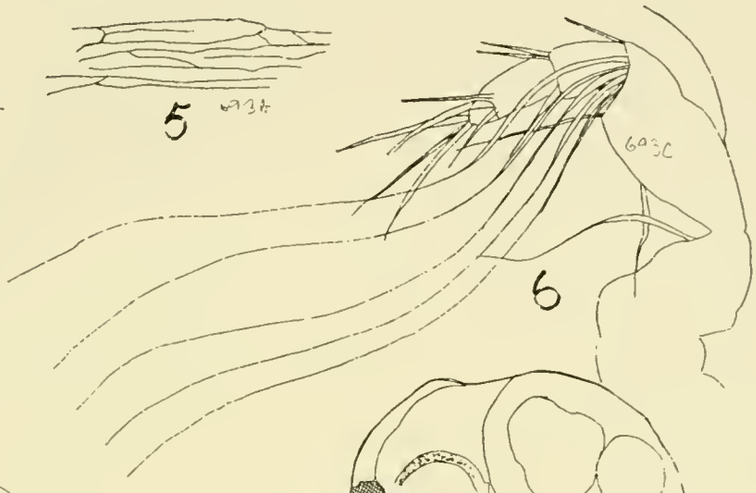

1


2


3

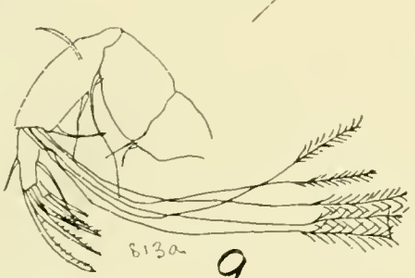
4

5


6

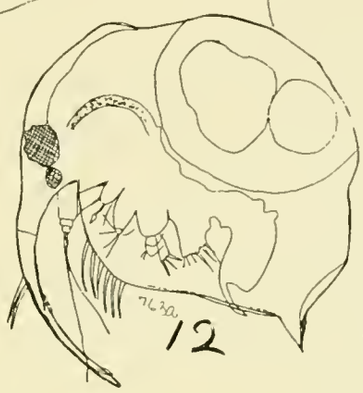
7

8


9

10

11

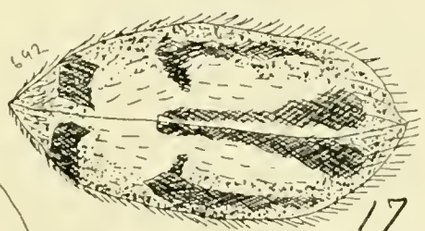

12

13

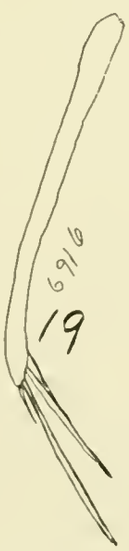
14

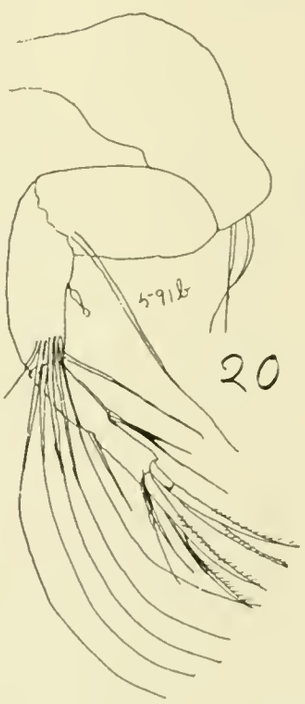
15

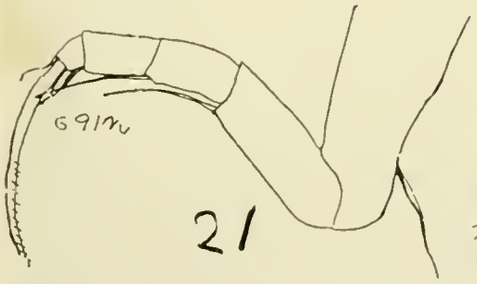
16

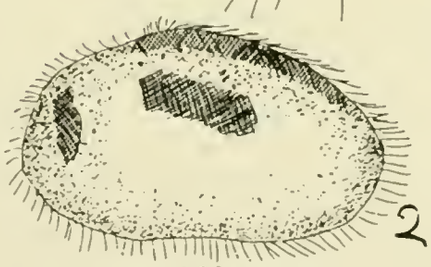

17

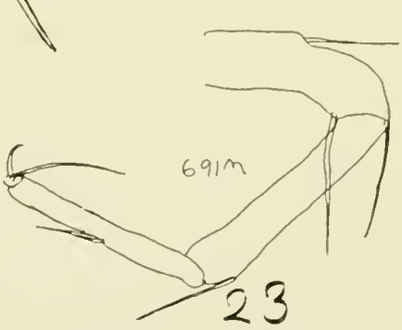
18

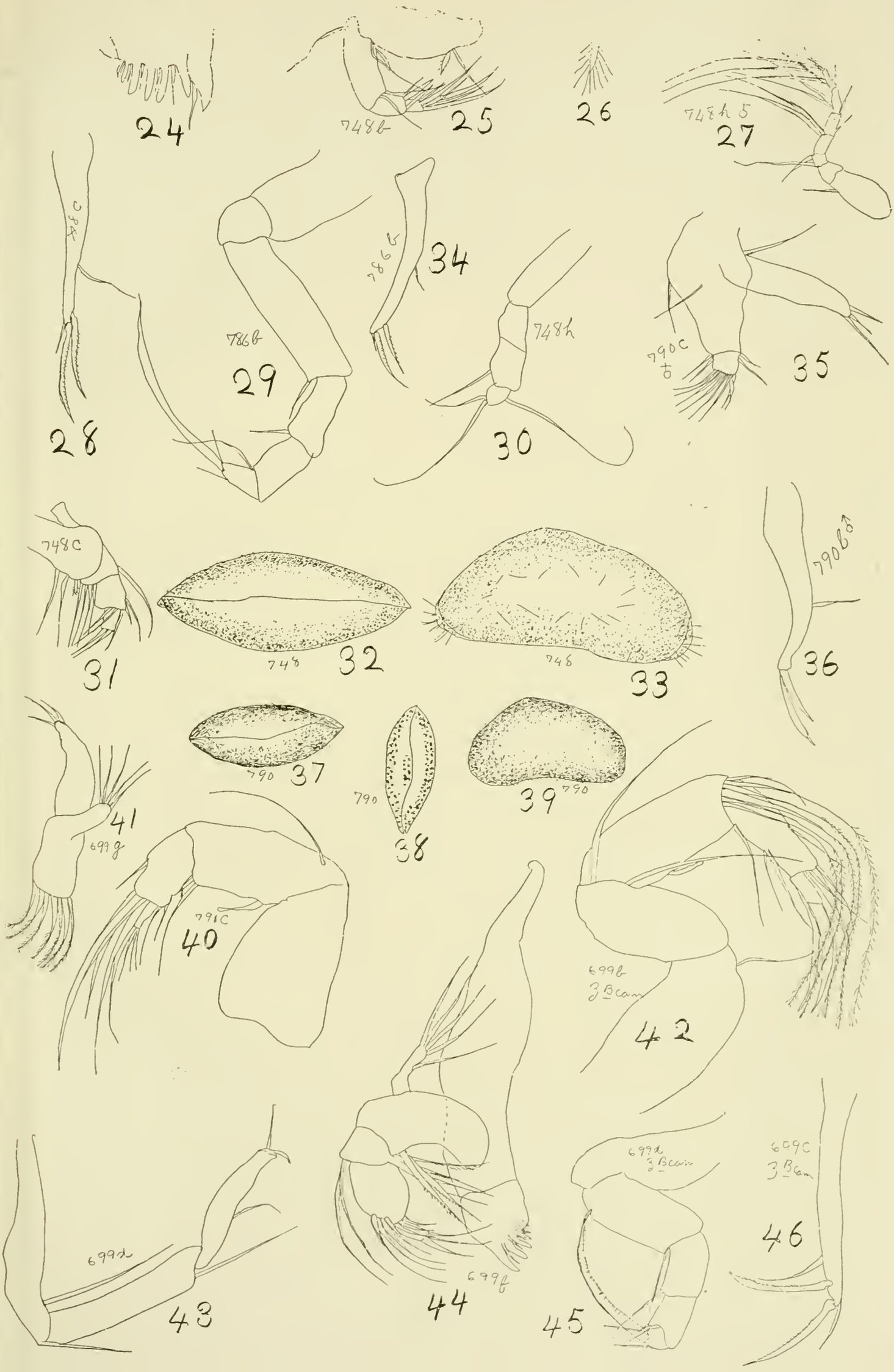

19


20


21


22


23


24
748b
25
26
748h 5
27
28
29
786b
34
786g
30
748h
790c
35
748c
31
748
32
748
33
790b
36
790
37
790
38
790
39
41
699g
791c
40
699b
3 Bcan
42
699a
43
44
699f
699a
3 Bcan
45
699c
3 Bcan
46

11,390.

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOL. VI. PART I.

WITH SEVEN PLATES.

EDITED BY

W. G. TIGHT, M. S.,

DEPARTMENT OF GEOLOGY AND NATURAL HISTORY.

CONTENTS:

	PAGE
Editor's Statement	3
List of Universities, Societies, etc., with which the BULLETIN Exchanges	4
Some Observations on the Crushing Effects of the Glacial Ice Sheet. Plates A to D. W. G. Tight	12
Biological Notes upon Fiber, Geomys and Erethyzon. C. L. and C. Judson Herrick	15
Studies in the Topography of the Rodent Brain: Erethizon Dorsatus and and Geomys Bursarius. Plates I to III. C. Judson Herrick	26
Meteorological Observations at Granville	47

GRANVILLE, OHIO, MAY, 1891.

PUBLISHED MONTHLY. COMMENCED JANUARY 1888.

The American Geologist.

ILLUSTRATED.

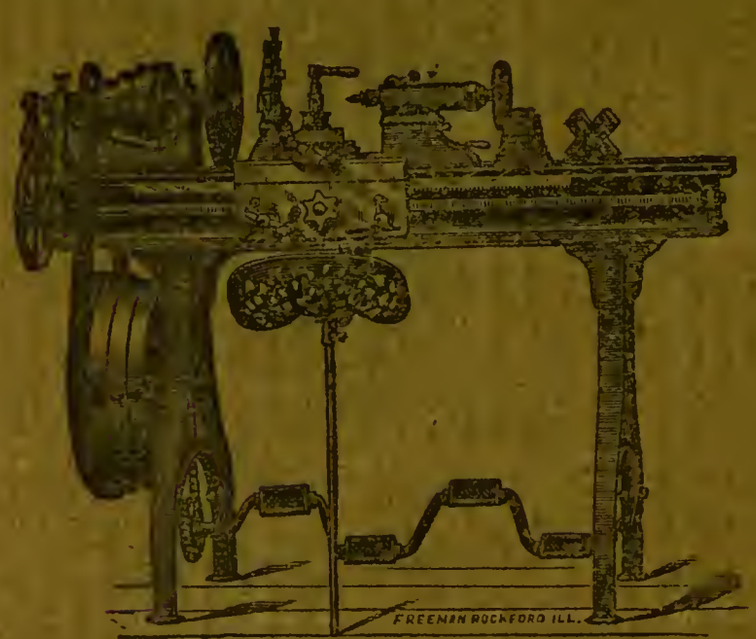
A Strictly Geological Journal.
Two volumes of 400 pages each, per year.

Subscription . . . . . $3.50 per Year.

EDITORS AND PROPRIETORS.

Samuel Calvin, Iowa City, Iowa.
Edward W. Claypool, Akron, Ohio.
John Eyerman, Easton, Pa.
Persifor Frazier, Philadelphia, Pa.
Clarence L. Herrick, Cincinnati, O.
Andrew C. Lawson, Ottowa, Ont.
Robert Hay, Junction City, Kansas.
Arthur Lakes, Golden, Col.
Edward O. Ulrich, Newport, Ky.
I. C. White, Morgantown, W. Va.
Newton H. Winchell, Minneapolis, Minn.

PUBLISHED AT MINNEAPOLIS, MINN.



Outfits complete for Schools of Industrial Training—with them a Practical Journeyman's Trade, in wood or metal, can be acquired. Illustrated catalogue free.

Barnes'
Patent Foot Power
Machinery.

For the Actual Business of the Workshop.

W. F. & John Barnes
COMPANY,
ROCKFORD, ILLINOIS,
479 Ruby Street.

FEB 17 1892

11,590.

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOL. VI. PART II.

WITH FIVE PLATES.

EDITED BY

W. G. TIGHT, M. S.,

DEPARTMENT OF GEOLOGY AND NATURAL HISTORY.

CONTENTS:

PAGE

Notes upon the Cladocera, Copepoda, Ostracoda and Rotifera of Cincinnati, with Description of New Species. Plates I-II. C. H. Turner-- 57

The Cerebrum and Olfactories of the Opossum, Didelphys [redacted] Virginica. Plates A, B and C. C. L. Herrick---------- 75

GRANVILLE, OHIO, JANUARY, 1892.

Denison University,

GRANVILLE, OHIO.

Has a beautiful and healthful location; a large and able faculty, Classical, Scientific, Latin and Greek Philosophical and English courses of study; Preparatory and Collegiate departments; a well organized Academy; a number of Free Scholarships; an excellent working Library; Laboratories and Workshop, with steam lathes, and iron and wood-working machinery; ample Chemical and Physical Apparatus; special provision for advanced students; facilities for original work in Science; good buildings and pleasant grounds; opportunities for self-help to students.

Expenses Unusually Low.

Fall Term begins Thursday, September, 1892.

For Catalogue or further information address,

D. B. PURINTON, *President*,

GRANVILLE, OHIO.

11,590

BULLETIN

OF THE

JAN 16 1893

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOLUME VII.

WITH ONE MAP.

EDITED BY

W. G. TIGHT, M. S.,

DEPARTMENT OF GEOLOGY AND NATURAL HISTORY.

CONTENTS:

PAGE.

Catalogue of the Phanerogams and Ferns of Licking County, Ohio.
By *Herbert L. Jones* ---------- 1-102

GRANVILLE, OHIO, MARCH, 1892.

PUBLISHED MONTHLY. COMMENCED JANUARY. 1888.

The American Geologist.

ILLUSTRATED.

A Strictly Geological Journal.
Two volumes of 400 pages each, per year.

Subscription, ... $3.50 *per Year.*

Sample Copies, 20 cents.

EDITORS AND PROPRIETORS.

Samuel Calvin, Iowa City, Iowa.
Edward W. Claypole, Akron, Ohio.
John Eyerman, Easton, Pa.
Persifor Frazdcher. Philadelphia, Pa.
I. B. Tyrrell, Ottawa, Ont.
Robert T. Hill, Washington, D. C.
R. D. Salisbury, Madison, Wis.
Andrew C. Lawson, Berksley, Cal.
Edward O. Ulrich, Newport, Ky.
I. C. White, Morgantown, W. Va.
Newton H. Winchell, Minneapolis, Minn.

PUBLISHED AT MINNEAPOLIS, MINN.

JOHN HASTINGS, *Pres. & Treas.*
JOSEPH TRIPP, *Vice Pres. & Gen. Manager.*
CHAS. S. LAWRENCE, *Secretary.*

ENGRAVING FOR ALL ILLUSTRATIVE AND ADVERTISING PURPOSES

67-71 PARK PLACE
NEW YORK.

11,590

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOL. VIII. PART I.

WITH TWO PLATES.

EDITED BY

W. G. TIGHT, M.S.,

DEPARTMENT OF GEOLOGY AND NATURAL HISTORY.

CONTENTS.

I. Additional Notes on the Cladocera and Ostracoda of Cincinnati, Ohio. 1. Systematic portion, with description of New Species. 2. Late larval history of *Cypris Herricki*. 3. *Ilyocryptus spinifer*, Herrick, not the same as *Ilyocryptus Longiremus*, Sars. With two Plates. C. H. TURNER ---------- p 1-18

II. The Eructavit, an Old French Paraphrase in verse of Psalm XLV. GEORGE F. MCKIBBEN, A.M., Professor of the French and German Languages ---------- 19-48

III. Lantern Slides without a Negative, W. G. TIGHT, Assistant Professor of Geology and Biology ---------- 49-51

GRANVILLE, OHIO, MAY, 1893.

PUBLISHED MONTHLY. COMMENCED JANUARY, 1888.

The American Geologist.

ILLUSTRATED.

A Strictly Geological Journal.

Two volumes of 400 pages each, per year.

Subscription, ... $3.50 *per Year.*

Sample Copies, 20 cents.

EDITORS AND PROPRIETORS.

Samuel Calvin, Iowa City, Iowa.
Edward W. Claypole, Akron, Ohio.
John Eyerman, Easton, Pa.
Persifor Frazdcher, Philadelphia, Pa.
I. B. Tyrrell, Ottawa, Ont.
Robert T. Hill, Washington, D. C.
R. D. Salisbury, Madison, Wis.
Andrew C. Lawson, Berksley, Cal.
Edward O Ulrich, Newport, Ky.
I. C. White, Morgantown, W. Va.
Newton H. Winchell, Minneapolis, Minn.

PUBLISHED AT MINNEAPOLIS, MINN.

DENISON UNIVERSITY,

GRANVILLE, OHIO.

Has a beautiful and healthful location; a large and able faculty, Classical, Scientific, Latin, Greek, Philosophical and English courses of study; Preparatory and Collegiate departments; a well organized Academy; a number of Free Scholarships; an excellent working Library; Laboratories and Workshop, with steam lathes, and iron wood-working machinery; ample Chemical and Physical Apparatus; special provision for advanced students; facilities for original work in Science; good buildings and pleasant grounds; opportunities for self-help to students.

Expenses Unusually Low.

For Catalogue or further information address,

D. B. PURINTON, *President,*

GRANVILLE, OHIO.

11,590

BULLETIN

OF THE

Scientific Laboratories

OF

DENISON UNIVERSITY.

VOL. VIII, PART II.

WITH EIGHT PLATES AND NINE CUTS.

EDITED BY

W. G. TIGHT, M.S.,

Department of Geology and Natural History.

CONTENTS.

I. Additions and Corrections to the Flora of Licking County, Ohio. H. L. JONES, Instructor in Botany at Harvard ------ 3-6

II. Notes from the Botanical Laboratory, (with 9 Figures and 1 Plate,) W. G. TIGHT, Assistant Professor of Geology and Natural History, Denison University ------ 7-12

III. Notes on American Ostracoda, with Descriptions of New Species, (with 2 Plates.) C. H. TURNER, Professor of Biology, Clark University, Georgia ------ 13-26

IV. Electricity as a Laboratory Servant. A. D. COLE, Henry Chisholm Professor of Chemistry and Physics, Denison University ------ 27-34

V. A Contribution to the Knowledge of the Preglacial Drainage of Ohio, Part I, (with 5 Plates.) W. G. TIGHT, Assistant Professor of Geology and Natural History, Denison University ------ 35-63

GRANVILLE, OHIO, JUNE, 1894.

Commenced January, 1888. Two Volumes a Year

THE

American Geologist

1894

The Oldest Exclusively Geological Magazine Published in America

IT IS NOT THE ORGAN OF ANY INSTITUTION, NOR OF ANY SECTION OF THE COUNTRY, NOR OF ANY PARTY.

To Subscribers in the United States, Canada and Mexico____$3.50 a year
To other Subscribers in the Postal Union_____$4.00 a year

The numbers for 1888 will hereafter be sent to new subscribers for $3.50, or bound in cloth for $4.50; those for 1889, 1890, 1891, 1892 and 1893 for $2.50 each, or bound for $3.50 each. New subscribers who remit $20 will receive all back numbers and the subscription for 1894. Fifty cents per year postage must be added to these rates for subscribers not living in North America. If bound volumes are ordered the cost will be $24.50, and the transportation must be paid by the subscriber. There are two volumes in each year, each volume having over 400 pages.

☞Sample Copies 20 cents.

THE GEOLOGICAL PUBLISHING CO.,
Minneapolis, Minn., U. S. A., Sept. 20, 1893.

THE JOURNAL

OF

Comparative Neurology

AN

Illustrated Magazine Published Quarterly.

DEVOTED TO THE

Comparative Study of the Nervous System in All Its Aspects.

Reviews and digests of current literature and complete bibliographical index every quarter. This department is rendered especially attractive in the present volume by the introduction of illustrated reviews.

Subscription, ... $3.50 per Year.

EDITED BY

C. L. HERRICK,
Professor in Biology in Denison University.

C. JUDSON HERRICK,
Fellow in Neurology, Denison University.

GRANVILLE, OHIO, U. S. A.

3 2044 106 25

Date Due

19 May '49

19 May '49